DOCTOR OF PHILOSOPHY

Competitive selection and international trade under monoplistic competition

Montagna, Catia

Award date:
1995

Competitive selection and international trade under monoplistic competition

Catia Montagna

1995

University of Dundee

COMPETITIVE SELECTION

AND

INTERNATIONAL TRADE

UNDER

MONOPOLISTIC COMPETITION

Catia Montagna

Degree of Doctor of Philosophy

Department of Economics and Management

University of Dundee

September 1995

Table of Contents

List of Tables and Figures

CHAPTER 1

CHAPTER 3

CHAPTER 6

Acknowledgements

A special thank goes to Mono Chatterji for his stimulating supervision and to Hassan Molana for his critical encouragements. I also owe a lot to all my other colleagues in Dundee, where parts of this thesis were presented in seminars and workshops. In particular, I wish to thank Alec Gee and David Young.

This work has greatly benefited from discussions with Luciano Boggio, and from the comments of those attending seminars at various Universities. I am also grateful to the participants to recent meetings of the Royal Economic Society and of the European Economic Association where papers based on this thesis were presented. I am particularly indebted to Dermot Leahy and Peter Neary. I would also like to thank Betty Frame for her invaluable secretarial assistance.

Finally, last but not least, my unlimited gratitude goes to Arci for all his patience and support.

Declaration

I declare that I am the author of this thesis and that I have consulted all the references cited. All the work of which the thesis is a record has been done by myself and has not been previously accepted for a higher degree.

Catia Montagna

Conditions of Ordinance and Regulations

I certify that Catia Montagna has spent the equivalent of twelve terms in the Department of Economics and Management, University of Dundee engaged in research work under my supervision. She has fulfilled the conditions of Ordinance n.39 at the University of Dundee and is therefore qualified to submit the accompanying thesis in application for the Degree of Doctor of Philosophy.

Monojit Chatterji

Professor Monojit Chatterji

Summary of the contents

The industrial economics and trade theory literatures of Chamberlinian monopolistic competition generally assume homogeneity of technologies between firms and countries. This assumption clashes with the evidence emerging from even a casual observation of the real world where industries - including those exposed to international competition - are characterized by persistent efficiency gaps both within and across countries.

This thesis constructs a monopolistically competitive framework of non-localized competition where inter-firm and inter-country technical heterogeneity is explicitly allowed for and modelled as randomly determined and persistent efficiency gaps.

The effects of inter-firm efficiency gaps on the long-run equilibrium of the monopolistic competition model are analyzed. In the presence of cost asymmetries free entry leads to the endogenization of the level of industry efficiency through a competitive selection process whereby more efficient entrants displace less efficient incumbents in the industry. Contrary to the standard model, entry will not drive profits to zero for intra-marginal firms and the long-run equilibrium will be characterized by a dispersion of efficiencies, market shares and profits.

The implications of technical heterogeneity for international trade have been analyzed by constructing a two country model where an efficiency gap between the two competitors takes the form of a

difference in the mean of their efficiency distributions. The results stemming from the analysis differ significantly from the predictions of the standard homogeneous technology model and cast doubt on the widely acknowledged role of trade as a source of industry rationalization. Trade is shown to affect efficiency on two levels and with respect to both the two countries experience asymmetric effects. By unifying the competitive conditions in which firms operate, at the industry level trade modifies the efficiency structure of the population of firms which survive in steady-state. At the firm level, it affects the expected scale of production of firms. These asymmetric efficiency effects generate a pattern of international specialization characterized by asymmetric market shares. The welfare effects of trade are also asymmetrically distributed between the two countries and circumstances are identified in which at least one country experiences a net welfare loss from trade.

Chapter 1

INTRODUCTION

During the last fifteen years the theory of international trade has witnessed developments almost without precedent in its two hundred year history of accepted and virtually unchallenged paradigms. Novel features of modern international trade have highlighted the limits of traditional theoretical frameworks to provide plausible answers to emerging issues. Orthodox doctrines, based on perfect competition - requiring homogeneous goods produced under convex technologies - have been complemented by new ones where imperfect competition, economies of scale and differentiated goods play a dominant role. A close integration between the trade and the industrial economics literature is the common denominator to the proliferation of models produced in recent years. This work is no exception to this latest tradition and relies - even more heavily than others - on the consonance between industrial economics and trade theory.

1.1. THE CHANGING NATURE OF WORLD TRADE

International trade is, increasingly, the object of attention in policy and journalistic forums. As is well documented[1], since the 1950s there has been a significant growth of international trade as a percentage of GDP for most industrial and many developing countries. Although this growth is to an extent attributable to a recovery to the levels prior to the protectionist period between the two World

[1] For a most recent example see Krugman (1995).

Wars[2], its occurrence has lent support to the view that a successful trade performance is synonymous with economic prosperity. This has clearly increased the pressure on trade economists to pursue a better understanding of the causes and consequences of trade. But the growth of world trade *per-se* would not have been a matter of serious concern for international trade theorists if it was not accompanied by striking changes in the patterns of international specialization. Indeed, these changes have undoubtedly had a role to play in the growth of trade volumes itself. The novel features of actual international trade flows concern both their commodity and geographical composition.

According to the vision emerging from traditional trade theories, trade enables countries to take advantage of their differences (in relative efficiencies or in factor endowments). Thus trade flows between two countries will be larger the more different the two trading partners are. This view was largely consistent with the nature of trade which prevailed at least until the First World War. Industrial economies would therefore specialize in exporting manufactures to less developed countries while their imports would mainly consist of raw materials and agricultural goods. Consistently, as reported by Krugman (1995), in 1913 75.5% of the United Kingdom's exports consisted of manufactures which accounted for only 20.2% of its imports. However, as emerges from Tables 1.1. and 1.2 below, this situation no longer holds: manufactures represent the greatest bulk of both the major OECD countries' exports and imports[3].

---

[2] See Krugman, 1995.

[3] In these and in the following tables, the data for Germany only include the Federal Republic, *i.e.* the former "West Germany".

Table 1.1: Manufacturing trade as a percentage of total trade (1989)

	EC-12[4]	U.S.	Japan
Imports	*78.7*	*85.1*	*65.3*
Exports	*94.2*	*88.5*	*99.4*

Source: European Economy

Table 1.2: Manufacturing trade as a percentage of total trade (1992)

	Germany	France	Italy	U.K.	EC-12
Imports	*75.99*	*78.82*	*67.82*	*77.07*	*74.67*
Exports	*90.03*	*80.86*	*88.74*	*81.87*	*81.86*

Source: EUROSTAT External Trade Statistical Yearbook, 1993.

Furthermore, the geographical composition of some OECD countries' trade indicates that the majority of the latter occurs within the OECD group. Tables 1.3 and 1.4 show for the major European countries the geographical structure of exports and imports respectively. Clearly, trade with other OECD economies accounts for about 80% of these European countries' trade. Furthermore, a significant proportion of these countries' manufacturing trade takes place with other OECD countries. Table 1.5 gives the percentage of the four major European countries' manufacturing trade which takes place within the European Union (EC-12).

---

[4] These are Belgium, Denmark, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, West Germany, and the United Kingdom.

Table 1.3: EC exports by region, 1991 (% of total exports)

Export of / To	Germany	France	Italy	U.K.	EC-12
Germany	-	20.7	21.0	13.7	14.5
France	13.1	-	15.2	11.0	11.2
Italy	9.1	11.1	-	5.8	7.2
U.K.	7.6	8.9	6.7	-	7.4
Tot.Intra-EC	53.6	63.6	59.0	56.3	61.6
Other Europe OECD	17.9	7.4	11.6	9.4	11.4
USA	6.3	6.0	6.9	11.0	6.4
Japan	2.5	2.0	2.2	2.2	2.0
R.of W.	19.7	21.0	20.3	21.1	18.6

Source: European Economy, Annual report, 1993.

Table 1.4: EC imports by region, 1991 (% of total exports)

Imports of / From	Germany	France	Italy	U.K.	EC-12
Germany	-	20.7	20.9	14.7	14.3
France	12.2	-	14.2	9.2	9.6
Italy	9.2	11.0	-	5.4	6.8
U.K.	6.4	7.6	5.7	-	6.5
Tot.Intra-EC	54.5	64.2	57.7	50.1	58.6
Other Europe OECD	14.9	7.3	10.9	11.8	10.4
USA	6.1	8.3	5.6	12.5	7.7
Japan	5.3	2.9	2.4	5.7	4.3
R.of W.	19.2	17.3	23.4	19.9	19.0

Source: European Economy, Annual report, 1993.

Table 1.5: Intra-EC manuf. trade as a % of total manuf. trade (1991)

	Germany	France	Italy	U.K.	EC-12
Imports	55.11	69.19	66.80	51.63	62.11
Exports	52.24	61.49	58.29	51.54	58.98

Source: Eurostat External Trade Statistical Yearbook, 1993.

Both facts highlighted so far seem to be at odds with the predictions of the traditional theory based on comparative advantages. These are in fact countries whose economic similarity, as described by aggregate measures such as per capita GDP as well as their industrial structure, is such that virtually very little trade should be expected to take place between them on the basis of orthodox models. As documented by Dollar and Wolff (1993), an increasing degree of convergence has occurred between OECD countries' levels of per capita income during the post Second World War period. This convergence at the aggregate level is also associated with a similar structure of their economic activity, with manufacturing output representing a similar proportion of these countries' GDP. Also, as illustrated by Table 1.6 for the four major European Union countries, the structure of employment by broad economic sectors is not significantly different amongst them.

Table 1.6: Structural composition of employment (% of tot.)

	Germany		*France*		*Italy*		*U.K.*	
	1980	*1989*	*1980*	*1989*	*1980*	*1989*	*1980*	*1989*
1	*5.4*	*4.9*	*8.6*	*6.4*	*13.6*	*9.9*	*2.5*	*2.1*
2	*33.0*	*30.0*	*24.6*	*20.2*	*27.0*	*21.9*	*27.5*	*20.5*
3	*8.2*	*6.9*	*8.5*	*7.2*	*8.0*	*6.9*	*6.5*	*7.1*
4	*33.8*	*36.7*	*35.2*	*39.8*	*34.0*	*42.2*	*40.5*	*48.6*
5	*17.9*	*19.9*	*21.9*	*25.4*	*16.5*	*18.2*	*20.0*	*20.1*

1:Agricultural, Forestry and Fishery Products; 2:Manufactured Products; 3:Building and Construction; 4:Market Services; 5:Non-Market Services.

Source: European Economy.

The fact that manufactures are the major component of industrial production for OECD countries is not at odds with the orthodox trade literature. However, the fact that these countries - despite their high degree of similarity - mainly trade in manufactures with each other is obviously difficult to reconcile with the standard Heckscher-Ohlin and Ricardian frameworks which do not provide any rationale for trade flows between very similar countries and predict instead that the volume of trade between any two economies should be inversely related to their degree of similarity.

Another, more worrying, feature of real world trade for theoretical economists is represented by the evidence on the composition of trade flows which is also not consistent with the predictions of the standard models. As has been extensively documented in the literature[5], the great bulk of trade occurring between industrial countries in particular is **intra-industry** trade, that is it consists of the simultaneous importing and exporting of goods with similar factor intensities and produced within the same industry. Early empirical studies showed that all processes of regional integration after the Second World World (*e.g.* the formation of the European Community in 1958 or the U.S.-Canada auto pact in 1965) were followed by a balanced increase in export and imports within the same three-digit industrial categories. Balassa (1966) was amongst the first to attract attention to this type of exchange when studying the growth of trade in manufactures after the formation of the European Common Market. Later, Grubel and Lloyd (1975) were the first to carefully document the existence of intra-industry trade.

A significant amount of work has been done in this area providing ample evidence to support the view that intra-industry

---

[5] See for instance Balassa (1966), Grubel (1967), and Grubel and Lloyd (1975).

trade is an important phenomenon which affects the majority of trade in industrial products between industrialized and newly industrialized economies. A common measure of intra-industry trade is the Grubel and Lloyd index[6], given by

$$IIT_j = 1 - \frac{|X_{ji} - M_{ji}|}{X_{ji} + M_{ji}} \qquad (1.1)$$

where IIT_j is the degree of intra-industry trade for a country j, and X_{ji} and M_{ji} are the country's exports and imports of commodity i respectively. Clearly, $0 \leq IIT \leq 1$. If there is complete specialization, then one of X_{ji}, M_{ji} is zero and hence $IIT = 0$, that is there is no intra-industry trade. If $IIT = 1$, all trade is intra-industry. Table 1.7 shows the degree of intra-industry trade for some countries and some broad commodity groups.

Table 1.7: IIT by commodity and country, 1990

Country / *Commodity*	*Germany*	*U.K.*	*U.S.*	*Japan*
Chemicals	*0.758*	*0.899*	*0.75*	*0.990*
Special Industr.Machinery	*0.456*	*0.897*	*0.918*	*0.355*
Computers	*0.747*	*0.953*	*0.998*	*0.390*
Automobiles	*0.587*	*0.623*	*0.375*	*0.260*
Clothing	*0.521*	*0.607*	*0.173*	*0.002*
Precision Instruments	*0.716*	*0.916*	*0.677*	*0.704*

Source: U.N. Yearbook of International Trade Statistics.

Obviously, this type of trade cannot be easily be explained by traditional trade theories. Recent developments in the theory of

6 Most studies adopt this index. For a critical assessment of this index see Greenaway and Milner (1989).

international trade, starting with the work of Krugman (1979a, 1980, and 1981) Lancaster (1979, 1980) and Helpman (1981) have provided alternative explanations of the patterns of international specialization. This literature relies heavily on the industrial economics literature. Models based on imperfectly competitive market structures, utility functions which reward product diversity, and increasing returns to scale technologies have established a rationale for the empirical evidence. Thus, if there are internal economies of scale, countries will be able to produce only a relatively small sub-set of differentiated models of a good at relatively low unit costs. If the produced variants of the good are however sufficiently diversified, consumers' love of variety will generate intra-industry trade. As has been observed, it is undoubtedly true that the rise in intra-industry trade also depends on the changing nature of production in manufacturing activities. Not only do these make use of more differentiated inputs (another significant component of intra-industry trade), but the production process itself is increasingly being **"de-integrated"**, *i.e.* its different stages take place in different countries. The increasing degree of segmentation of the production process - to take advantage of local comparative advantages - into different phases located in different countries has certainly contributed to the large increase in the volume of intra-industry trade[7].

[7] On the empirical front, several studies have attempted to establish the basic determinants of intra-industry trade. We shall not survey this vast literature here. See Pagoulatos and Sorensen (1975), Loertscher and Wolter (1980), Caves (1981), Toh (1982), Bergstrand (1983), Havrylyshyn and Civan (1983), Balassa (1986) and Greenaway and Milner (1989) amongst others.

As is evident from Table 1.7, intra-industry trade varies across commodities. Thus, products which are more subject to differentiation and scale economies show higher degrees of intra-industry trade than less differentiated commodities whose production is not subject to significant economies of scale. So, for instance, technological differentiation and economies of scale are likely to be important factors for chemicals, computers, industrial machinery and precision instruments which show, in Table 1.7, relatively high values of the *IIT* index. Clothing is in general characterized by lower degrees of two way trade, thus suggesting a possible dominant role in this sector of comparative advantages. However, note that the index is higher for the U.K. and Germany, possibly reflecting the importance of cross border trade in fashion within the European Union. This points to another factor which emerges from these data, that is the variability of the degree of intra-industry trade across countries within the same industries which reflects geographical as well as historical reasons. Also, an aggregation problem exists in that when the intra-industry trade indexes are calculated for broad commodity groups they tend to overestimate the degree of intra-industry trade which reduces as the commodity categorization becomes more disaggregated.

1.2. DIFFERENT DEGREES OF INTRA-INDUSTRY TRADE PENETRATION

In general, theoretical models of intra-industry trade have focused on the **existence** of this two-way trade. In particular the earlier contributions in the literature have been concerned with providing an explanation of **why** two way trade within the same industry occurs between similar countries. The resulting models, particularly those built within the monopolistically competitive framework, have pushed to the limit the **similarity** between countries and have opted for an assumption of **identicality** of demand structures and production technologies. Perhaps not surprisingly, given the assumed existence of increasing returns and the utility functions rewarding product diversity, these models could indeed account for trade between identical economies. The fact that the pattern of intra-industry trade reflected the existence and persistence of high degrees of specialization did not play a central role amongst the factors driving the theory.

As can be seen from Table 1.7, even at a very high level of aggregation, the *IIT* index always suggests some degree of inequality between import and export flows. At a more disaggregated level this is even more evident. Table 1.8 proposes bilateral *IIT* indexes for the four major European Union countries in a few sub-product groups at the sixth-digit level of disaggregation. As the table illustrates, there is a high variability in the bilateral reciprocal degrees of intra-industry trade penetration and the *IIT* indexes are often very small. The extent of this is clearly affected by the bilateral nature of these indexes. The fact that intra-industry trade between any two countries is not balanced does not mean that in the aggregate these countries do not have a balanced trade in that industry. However even the very aggregated level of Table 1.7 - which by its very nature tends to overestimate the degree of intra-industry trade - shows that the two way trade is often far from being balanced. These data seem to suggest the existence of patterns of specialization which shape the structure of trade flows.

Table 1.8: Bilateral IIT indexes, 1991

Household Electrical Refrigerators	*U.K.*	*France*	*Germany*
France	*0.171*	-	
Germany	*0.595*	*0.068*	-
Italy	*0.000*	*0.603*	*0.04*
Kitchen/Household articles of stainless steel			
France	*0.611*	-	
Germany	*0.779*	*0.953*	-
Italy	*0.163*	*0.164*	*0.630*
Electro-Thermic Hair dryers			
France	*0.967*	-	
Germany	*0.549*	*0.162*	-
Italy	*0.057*	*0.362*	*0.423*

Source: EUROSTAT Analytical Tables of Foreign Trade - NIMEXE

Imperfect competition and product differentiation, while explaining the existence of intra-industry trade, are not sufficient *per se* to capture the different degrees of reciprocal trade penetration which show the extent to which specialization still exists amongst industrial economies.

Clearly, the assumption of symmetric trading countries leads to the prediction that the free-trade market is symmetrically shared between them. A notable exception to the symmetric market share result is Krugman (1980) where the presence of transport costs ensures that firms hold different shares in their domestic and foreign markets. Venables (1987) also obtains a similar result by allowing for both the presence of transport costs and asymmetric preferences where products from different countries have different weights in consumers' utility functions. Helpman and Krugman (1985) offer a key contribution to this literature by constructing a model, set in a Chamberlin-Heckscher-Ohlin framework, which incorporates factor endowments alongside increasing returns to scale and horizontal product differentiation. Their model thus generates both intra and inter-industry trade with the Heckscher-Ohlin component determining the pattern of inter-industry trade and with intra-industry trade being determined on the basis of the other factors, namely decreasing average costs and product differentiation. Also, the existence of differences in factor endowments affect the pattern of IIT, with one country being *net* exporter of the differentiated good, thus leading to an asymmetric division of the integrated differentiated market. These models clearly represent a big step towards reality.

1.3. TECHNOLOGY AS AN ASYMMETRY GENERATING FACTOR

As was discussed in Section 1.2, there are models of trade within the monopolistically competitive framework which generate asymmetric market shares in the intra-industry trade industries. The factor leading to these results are transport costs or the marriage between an Heckscher-Ohlin framework and a monopolistically competitive one. Note, however, that these models do not relax the assumption of identicality of countries **within** the intra-industry trade sector. In other words, the source of market share asymmetries lies outside the intra-industry trade sector itself. There are however reasons to express dissatisfaction with the current state of the art.

Even a casual observation of real world industries points towards the existence of a high degree of specialization between industrial countries, despite their very similar aggregate characteristics, such as per-capita GDP or per-capita industrial output. Dollar and Wolff (1993), analyzing 13 OECD countries whose manufacturing data has been disaggregated into 28 industries, note that despite the increase in the degree of aggregate convergence occurred in the post Second World War period, the sub-industries in which each country exports are quite different. As they stress, the export patterns of these countries are strikingly different when examined at a disaggregated level. This is clearly consistent with the different degrees of reciprocal intra-industry trade penetration noted above.

Dollar, Wolff and Baumol (1988) found a considerable variation across industrial countries in the value added per employee. Consistently, Dollar and Wolff (1993) find that while the aggregate labour productivity of industrial countries has converged to US levels, the degree of convergence is highly heterogeneous across industries. So, while at the **aggregate** level the gap between low productivity and high productivity countries has been shrinking (and the relative capital intensity of their manufacturing production has been converging), a leadership structure in total factor productivity (TFP) can easily be identified at a more disaggregated - industry or sub-industry - level. They state: "*convergence of aggregate labor and total factor productivity has resulted as countries improved their relative productivity in industries that differed from country to* *country.*" (Dollar and Wolff, 1993, p. 149). This leads to an aggregate productivity convergence which is higher than that in individual industries. "*A further result of this development, documented in this chapter, is that the trade patterns of the industrial countries are not converging or becoming more similar. This result is consistent with our conclusion that specialization has continued at the industry level in the advanced industrial countries.*" (Dollar and Wolff, 1993, p. 149). Thus, different countries had their strongest convergence in different industries. That is, despite leading to a great deal of convergence in the **average** TFP of the economy, this has generated different patterns of production and export specialization.

It is plausible to think that a crucial role in determining the differences in TFP at the industry level documented by Dollar and Wolff (1993) is played by technology. As strongly and convincingly argued by the relatively recent evolutionary literature, technology is by its very nature **firm** and **country-specific**. The work of Rosenberg (1982), Nelson and Winter (1982), Dosi (1988) and Dosi *et al.* (1988) stresses how technology - which is embodied in people and organizations - reflects specific, local, and only partially appropriable knowledge. Such a view of technology "*can account for the continuous existence of technology gaps between firms and between countries*" (Soete, 1990, p.11). Also, the "*relatively ordered, cumulative and irreversible pattern of technical change*" (Soete, 1990, p.11) reflects the cumulative nature of technical knowledge, hence explaining the persistence over time of both these gaps and the structure of leadership positions of countries in international markets. As a result, the international intersectoral composition of countries' trade can be explained essentially by technology gaps.

Although the localized nature of technical knowledge has widely been disregarded in the mainstream industrial economics and trade literature, extensive empirical work has documented the firm-specific nature of technology. A number of studies suggest that a wide range of firm and plant efficiencies coexist and persist even in industries with competitive national and international markets. Taussing (1919) showed that a wide variation of costs existed within American industries. Within industry dispersion of companies by profit margins was also documented by Coates (1927) for British industries. More recently, Caves (1991) finds, for the U.S., Canada, Japan, Australia and South Korea, a considerable variation of technical inefficiencies across firms both between countries within the same industry and between industries[8]. Hart and Shipman (1992) find within industry dispersion of labour productivity and show that this dispersion differs significantly between the U.K. and Germany.

1.4. COMPETITIVE SELECTION AND TRADE: AN OVERVIEW

The central idea of this thesis is that patterns of international specialization are influenced by an **asymmetric** distribution **between firms** and **between countries** of technological and organizational capabilities. Even when employing the same broadly defined technology firms use different types of knowledge which is, to an extent, firm and country-specific, because it is the product of

[8] For a recent survey of the extensive empirical literature in the area see Green *et al.* (1991).

past experience and reflects institutional and historical factors. These features of technology determine patterns of international exchange between **similar countries** which, although characterized by intra-industry trade, reflect persistent country specific domains in some productions (Porter, 1993) and can in principle explain the different degrees of intra-industry trade penetration empirically observed. Thus, dispersion will emerge within an industry in productivity levels, profit rates, firm size and export performance. This will obviously have a repercussion on the composition and volume of trade. In fact, this distribution of firms' efficiency will overlap (determine and being determined by) with the country comparative advantage. As argued by Abd-el-Rahman (1991) firms operating within the same industry are distinguished by specific competitive advantages and disadvantages but *"against a background of collective comparative advantages"* related to the industry and country in which they operate.

The firm and country-specific nature of technology has not played a central role in either the industrial economics or the international trade literature. In particular, within their Chamberlinian monopolistic competition strands, these two areas of the literature have not taken account of inter-firm differences in technology. Trade theory has also generally disregarded inter-country efficiency gaps within the imperfectly competitive industry.

The cost of the assumption of technical homogeneity is significant and not limited to the positive implications of the analysis. In fact not only does the symmetry hypothesis generate a failure to capture an important aspect of the pattern of specialization, but also has important implications as to the gains from trade. Models of monopolistic competition generally support the view that trade benefits symmetrically all partner countries. On one hand, the increased competition leads to a rationalization of the industry and generates efficiency gains. On the other hand, in an environment characterized by a taste for variety, trade increases consumer welfare *via* an increase in the number of goods available for consumption.

The recent debate about the effects of the implementation of the Single European Market has centred around the role of trade in increasing competition in most industries thus leading to the need for firms previously protected by trade barriers to pursue - in order to survive - efficiency improvements. The same line of arguments has led commentators to predict the effects of trade on the competitive selection process within industries, whereby only the more efficient firms would manage to survive at the expense of less efficient ones. Most of the new theoretical literature on imperfect competition, however, cannot deal with this aspect because of the assumed technical homogeneity between firms. Despite the centrality of industrial structure in determining the patterns of trade, this literature does not allow one to analyze some of the most important effects of trade on market structure itself, *i.e.* its effects on the competitive selection process within industries.

1.4.1. The aims of the thesis

On the basis of the above considerations, the main aims of this work are the following:

(1) To construct a monopolistically competitive framework capable of taking into account inter-firm and inter-country differences in efficiency.

(2) To analyze the role of inter-firm efficiency gaps in determining the long-run equilibrium nature of the monopolistic competition model of Chamberlinian tradition.

(3) To examine the role of inter-firm and inter-country efficiency gaps in determining trade patterns and in affecting the welfare effects of trade.

(4) To analyze the impact of trade liberalization on the competitive selection processes of industries characterized by different levels of efficiency.

Clearly the focus of this work is not merely on international trade issues, a significant emphasis being placed on the closed economy monopolistic competition model.

1.4.2. Modelling strategy and main results

The monopolistic competition strand of the literature within which the analysis has been carried is the representative consumer framework of non-localized competition. Generally, this type of models assume firms' technical homogeneity[9]. Within a partial equilibrium framework of analysis, we develop a standard Dixit-Stiglitz (1977) type model of monopolistic competition to allow for technical heterogeneity amongst firms. As in Dixit and Stiglitz (1977), all consumers are assumed to be identical in tastes and

[9] The few exceptions to symmetry which can be found in the product differentiation literature are provided by address models of Hotellian tradition.

income and no explicit representation is offered of the product space.

The modelling of technology is kept as simple as possible. The central assumption is the existence of a distribution of firms' efficiency within the industry. Hence, inter-firm technical asymmetries take the form of firm-specific marginal production costs generated by a random process. The distribution is exogenously given, as if describing a historically determined state of technology. Market structure is determined endogenously as the outcome of a process of competitive selection whereby more efficient entrants displace less efficient incumbents. The competitive process is shown to lead to the simultaneous determination of both the number of firms in the industry and the minimum level of efficiency required to survive, *i.e.* the industry efficiency cut-off point.

No technical progress is assumed to take place in the model and inter-firm efficiency gaps are given, persist over time, and are not affected by knowledge spill-overs and/or by imitation processes. As has been powerfully stressed, *"the evolutionary pattern of any one industry will be characterised by both mechanisms of 'Darwinian' selection and 'Lamarkian' learning/adaptation/imitation"* processes (Dosi, Pavitt and Soete, 1990, p.116). However, despite our awareness that in real world industries "Lamarkian" dynamic forces are bound to interact and affect the competitive selection process itself, we choose to confine our analysis to the former. By focussing on the "Darwinian" selection between firms with **given** different efficiencies, our model allows to highlight important features of competition in a monopolistically competitive market. The results of the analysis differ significantly from those stemming from the standard homogeneous firms model. In particular,

(1) The assumption of firm-specific costs leads to the endogenization of the steady-state level of the industry technical efficiency. The latter will turn out to be a function of the parameters which determine the toughness of price competition. The result is the emergence of a relationship between industry efficiency, concentration and profitability which is not always consistent with that stemming from the standard version of the model.

(2) The asymmetry of costs, together with the uncertainty as to the efficiency potential entrants will obtain, imply the long-run persistence of positive profits for intra-marginal firms.

(3) The steady-state will be characterized by a **spectrum** of quantities, prices and profit rates.

The modified monopolistic competition model is subsequently used to analyze trade between two **similar** but **not identical** countries. On the demand side of the model the assumption of symmetry is retained. Hence the two countries' consumers are identical in every respect. On the supply side, both countries' industries are characterized by heterogeneous firms, where an efficiency gap exists between the two industries. The latter is assumed to consists of a **given** difference in the mean of the two distributions of marginal costs. This efficiency gap is meant to reflect historically determined country-specific states of technology. Clearly, one could argue that trade flows are likely to generate knowledge spill-overs between countries which ought to reduce, to an extent, country differences in efficiency. Here, however, we lay the emphasis on the effects on trade performance of the existence of persistent efficiency gaps between firms and countries.

Our model allows to illustrate the important phenomenon that, by unifying the efficiency conditions in which firms from different countries have to operate, trade liberalization changes the nature of the competitive selection process of national industries. By focussing on the competitive selection effects of trade, we shall show how the latter influences the (steady-state) state of technology even in the absence of convergence mechanisms (such as knowledge spill-overs and imitation) and asymmetry creating forces (such as firm-specific innovation).

The results stemming from this framework challenge the predictions of the standard monopolistic trade model in a number of ways. In particular,

(1) The integrated market is not symmetrically shared between countries, with the more efficient country supplying a bigger number and larger quantities of varieties than the less efficient one. Thus, the model provides a rationale - stemming from factors **within** the monopolistically competitive industry - for different degrees of intra-industry trade penetration.

(2) If competition is very selective, the less efficient country's industry may be unable to survive foreign competition and the more efficient country will serve the whole of the integrated market.

(3) Two types of efficiency effects of trade are identified, one at the industry and one at the firm level. With respect to both, trade affects the two countries asymmetrically. In particular, at

both levels, one of the two countries will experience an adverse efficiency effect. Thus, the results of the analysis cast doubt on the standard prediction that trade, *via* competition, leads to **generalized** efficiency gains.

(4) Welfare gains are not symmetrically spread across countries and circumstances are identified in which at least one of the two countries experiences a net welfare loss as a result of trade.

Despite the significant normative implications of the results of this work, we do not carry out here any policy analysis. This task lies beyond the the scope of this thesis and is left for future research.

1.4.2. An outline of the thesis

The rest of the thesis is organized as follows.

Chapter 2 surveys the (closed economy) monopolistic competition literature. Particular emphasis is put on critically assessing the features of the representative consumer non-localized competition strand of the literature.

The main part of Chapter 3 is devoted to developing the heterogeneous firms monopolistic competition model, to analyze its steady-state features and to compare its predictions to those stemming from the homogeneous firm case.

Chapter 4 surveys the relevant trade literature. Chapter 5 is a transitory chapter, in which an autarkic inter-country comparison is carried out in order to highlight the market structure implications for the less efficient country of its efficiency disadvantage. The main aim of the chapter is to provide a useful benchmark for the subsequent analysis of the effects of trade on market structure.

The trade model is developed in Chapter 6 where the efficiency effects of trade are analyzed and their positive and welfare implications are highlighted.

Chapter 7 concludes the thesis and identifies some areas for future research.

Finally, some of the results obtained throughout the thesis are supported by simulation methods. The choice of numerical evaluations, in addition to being dictated by the analytical intractability of some of the relationships, has been made in order to illustrate graphically the behavior of the variables for plausible ranges of parameters values.

Chapter 2

HORIZONTAL PRODUCT DIFFERENTIATION AND MONOPOLISTIC COMPETITION: A SURVEY

> *"These three elements - variety among individual preferences, potential variety among products, and economies of scale - are all present in the consumer-products sector of advanced industrial societies."*
>
> **Lancaster,** 1979

2.1. INTRODUCTION

The aim of this chapter is to discuss the relevance of the phenomenon of product differentiation to the industrial economics literature. Given the extent of the field, and given the more specific aims of this study, the analysis will be limited to what is generally referred to as **horizontal** product differentiation. That is, we shall not concern ourselves with the **vertical** product differentiation literature.

In general, products differ on the basis of the characteristics they possess. Some of these characteristics generate **objective** differences between the varieties of the good under consideration. In this case consumers can be expected to have homogeneous preferences as to the consumption of which variety generates the highest utility. Different varieties can be ranked in terms of their **level of quality** and all consumers would agree on the ranking. Consumption choices will then be determined by other aspects, such as the level of income. It follows that the coexistence in the market of low and high quality products rests on price differences such that the *a priori* attractiveness of a superior quality is compensated by the lower price of an inferior one. This is what is meant by **vertical** product differentiation.

Horizontal product differentiation, instead, is rooted in taste differences. There are goods which have the same intrinsic quality level, and yet can be distinguished by consumers on the basis of other characteristics they possess. In this case there is no **natural ranking** of the varieties of the good. Other things being equal, consumption choices are made on the basis of preference structures which reflect the way in which consumers **subjectively** perceive and value these characteristics[1].)

2.2. HORIZONTAL PRODUCT DIFFERENTIATION AND PREFERENCES

Horizontal product differentiation is a major feature of real world markets and its full appreciation is essential to the understanding of the way economies operate. It is obvious that the origin of its existence lies in the great diversity of consumers' tastes. As stressed by Lancaster *"... individual variations in tastes and preferences are real and substantial in the sense that individuals consider themselves to be better off (or have a higher welfare) when they have a product which exactly fits their view of the ideal design for that class of products than when they do not"* (Lancaster, 1979, p. 5). The idiosyncratic nature of consumers' tastes is reflected in

1 Cremer and Thisse (1991) show that address models *à la* Hotelling are a special case of a vertical differentiation model.

the behaviour of producers who pursue forms of product differentiation. Indeed, even when products are very close substitutes and no substantial **objective** differences exist between them, producers intentionally engage in activities aimed at enhancing what consumers **subjectively** perceive as differences amongst goods and sellers. The extent of this phenomenon will vary over time and across countries and will be larger the higher, and the more evenly distributed, is income. Clearly, where basic needs are met, more intangible features of commodities - satisfying needs related to (or induced by) fashion, status, etc. - become important and determine consumption and choice.

As stressed by Anderson, de Palma and Thisse, "*... there are two levels of taste diversity. Individuals may want to consume different products on different occasions, expressing a preference for varieties over time (e.g., not eating the same dish at the same restaurant every night). Individuals may also have idiosyncratic tastes about their most preferred variants (e.g., beer drinkers and cigarette smokers often stick to brands they like best). Thus we view the population as a whole as heterogeneous, and this intra- and inter-individual heterogeneity generates a demand for product diversity in the aggregate.*" (Anderson, de Palma and Thisse, 1992, p.1). It is not difficult to imagine an idealized world where the number of individuals corresponds to the number of varieties, with each individual consuming a variety which differs in some respects from the ones most preferred by others. Technology, however, constraints the number of producible varieties. The existence of increasing returns to scale in production and in all other activities related to product specification is such that each firm needs to serve a sufficiently large portion of the market. Hence, the market will support a number of varieties which is smaller than the ideal one.

The literature on horizontal product differentiation has generated different approaches to the modelling of this phenomenon. A first classification can be made with respect to whether consumers' preferences are **heterogeneous** or **homogeneous**. Models based on the assumption of heterogeneous preferences across consumers are referred to as **address** or **characteristics approach** to horizontal product differentiation. Models which assume preference homogeneity across consumers generally fall into the so called **representative consumer approach**. Note that the representative consumer framework is often referred to as **Chamberlinian.** However, we think that the implications of this adjective go beyond the type of consumer preferences modelling strategy adopted. Whilst it is true that the representative consumer approach owes much of its development to Chamberlin's work, and despite the fact that Chamberlinian models are frequently characterized by the representative consumer assumption, many contributions make the hypothesis of heterogeneous consumers. In fact, in determining whether a model is Chamberlinian or not, the hypothesis about the nature of competition is more important than the distinction between homogeneous and heterogeneous tastes. Instead, the crucial distinction is between **localized** and **non-localized** competition. As we shall see, a fundamental hypothesis of Chamberlinian models is the **symmetry** of preferences which implies the absence of neighbouring effects between goods, so that firms do not have any direct competitors but compete with all others simultaneously. This is a case of non-localized competition. Whilst the symmetry hypothesis is more common in representative consumer models, it is not inconsistent with the assumption of preference heterogeneity which characterizes address models. Hence, although representative consumer models are in general Chamberlinian, it is easy to find examples in the literature of address or characteristics models which also fall into this category[2]. These issues will be discussed more extensively later.

2.2.1. Heterogeneous preferences

In this sub-section we shall examine the main features of theoretical models based on heterogeneous preferences. The literature developed within this framework is extremely vast and our survey does not intend to be exhaustive. Rather, we shall try to highlight the main theoretical issues related to these contributions in order to relate them to the other body of literature based on homogeneous preferences.

2.2.1.1. The address or characteristic approach

The **address approach** (or **characteristic approach**) to product differentiation has developed along the lines set out by Hotelling's seminal work (1929). Central to this class of models is the hypothesis that consumers have **heterogeneous preference structures** whereby each individual has an **ideal variety** which differs in some characteristics from the ideal variety of other consumers. It follows that both individuals and variants of a good can be described by particular **locations** (points) in the characteristic space. This idea builds on the work of Lancaster (1966, 1971, 1979, 1991a) who suggested that a

[2] See, for example, Hart (1985a, b).

good can be seen as a bundle of characteristics. A commodity is not valued *per se*, but for the attributes it embodies, which form the basis of consumers preferences.

Let M be the number of characteristics of a horizontally differentiated good, with $\mathbb{R}^M$ being the **characteristic space**. Hence, each existing and ideal variety of the good can be described by a point belonging to $\mathbb{R}^M$. Assume that there are N $(N>2)$ currently produced varieties. Each variety i of the differentiated good can then be described by a vector $q'_i=(q_i^1,\dots,q_i^M)$ whose elements indicate the **"quantity"** of each characteristic it possesses and which determines the point at which the variety i is located, *i.e.* its address in the characteristic space. Hence, the N varieties are located at $q'_1, \dots, q'_i,\dots, q'_N$, with $q'_i \neq q'_j$ for all i, $j=1,\dots,N$ and $i \neq j$.

If consumers' preferences are defined over the characteristic space, each individual will be located at the point corresponding to his/her ideal variety. Frequently, in this literature, each individual buys only one variant of the good; furthermore, in many models it is assumed that only one unit of the chosen variety is purchased. This implies that buyers are partitioned in sales areas which do not overlap[3]. For simplicity, in the analysis that follows we shall retain both of these assumptions.

Consider a population of Z consumers, each located at the point corresponding to his/her ideal variety $\hat{q}$, where $\hat{q}'=(\hat{q}^1,\dots,\hat{q}^M)$. Varieties which are close to an individual's ideal one will be valued more than varieties which are at a more distant location[4]. Note that

---

[3] See Phlips and Thisse, 1982.

[4] Here we are implicitly assuming that - at least at the **individual** level - preferences are **asymmetric**. As we shall see, this does not

an individual's ideal product specification may or may not be produced and hence may not be available for consumption. Also, even if the ideal variety is amongst the existing ones, a consumer may find that it is sold at too high a price and thus prefer a cheaper neighbouring variety. Hence, consumer's choice will represent a compromise between his/her preferences, reflected in the set of characteristics defining the ideal product specification, and the availability and/or the price of each good. The chosen variant will be the one which yields the greatest utility, *i.e.* the variety whose specification is closest to the ideal one.

The utility of a consumer purchasing a variety i will be inversely related to the **distance** in the characteristic space between the location of his/her ideal variety and that of variety i. The larger is this distance, the higher is the **disutility cost** incurred by the consumer from not buying $\hat{q}'$. It follows that the further away is a brand from a consumer's ideal location (i.e. set of characteristics) the lower will be the degree of substitutability between the two varieties. Within a geographical analogy, the disutility attributable to not consuming one's ideally preferred good can be seen as a transport cost, with an individual's geographical location being interpretable as his/her product specification[5].

Let us define the Euclidean distance between the consumer's ideal

prevent models developed in this framework to assume **symmetric** preferences at the **aggregate** level.

[5] Lederer and Hurter (1986), MacLeod, Norman and Thisse (1985), Greenhut, Norman and Hung (1987) and Anderson and de Palma (1988) provide analyses of how the spatial model can be interpreted as a model of product location in characteristic space.

variety and a variety i as $d_i=(q_i-\hat{q})$, from which follows that the square of the Euclidean distance between the locations of the two goods in the characteristic space will be $\sum_{k=1}^{M}(q_i^k-\hat{q}^k)^2 = d_i'd_i$. We can now define the indirect utility of a consumer whose ideal bundle of characteristics is $\hat{q}$ but who purchases q_i as[6]

$$U_i(q_i) = V_i - \alpha\ (d_i'd_i) \tag{2.1}$$

where α is a positive constant. V_i is given by

$$V_i = A + \gamma_i - P_i \tag{2.2}$$

where A is a measure of nominal income, γ_i is a scalar which represents a quality index of variety i and P_i is the price of variety i. If the only difference amongst consumers is in their tastes, V_i is equal for all and can be seen as representing the observable (objective) features of the good. Instead, the second term of equation *(2.1)*, despite having the same functional form across consumers, is individual specific in that it is evaluated at individual locations $\hat{q}$ in the characteristic space and represents the disutility cost to the consumer from not purchasing his/her ideal variety.

Given that each consumer is generally assumed to purchase only one single unit of a single variety of the differentiated commodity, individual behaviour in not consistent with traditional consumer theory based on continuous and convex preferences. Indeed, the assumption of only one variant of the good being purchased implies that consumers are "*at corner solutions with respect to most goods in*

---

[6] This specification of the utility function has been recently used is several models. See Eaton and Wooders (1985) and Anderson, de Palma and Thisse (1989) amongst others.

the group" (Archibald, Eaton and Lipsey, 1986). This discontinuity in consumer behaviour is reflected in **discontinuous individual** demands. Nevertheless, **continuous aggregate** demand functions for each variety of the good can still be obtained. As suggested by Hotelling himself, aggregate demand functions can be derived by assuming a given taste distribution in the characteristic space of the population of heterogeneous consumers[7]. Following Anderson, de Palma and Thisse (1989), we assume that the Z consumers are distributed in $\mathbb{R}^M$ according to a continuous and strictly positive density function $f(\hat{q})$, where $\hat{q}'=(\hat{q}^1,\ldots,\hat{q}^M)$ and $\int_{\mathbb{R}_M} f(\hat{q})d\hat{q}=Z$. The market space of a variety i can then be defined as

$$S_i = \{q_i \in \mathbb{R}^M \mid U_i(q_i) \geq U_j(q_j),\ j=1,\ldots,N,\ j \neq i\} \tag{2.3}$$

which corresponds to the set of types of consumers for which variant i is weakly preferred to all others. Given equations *(2.1)* and *(2.2)*, the market space for variety i can be re-written as

$$S_i = \{q_i \in \mathbb{R}^M \mid V_i - V_j \leq \alpha\ (d_i'd_i - d_j'd_j),\ j=1,\ \ldots,\ N,\ j \neq i\} \tag{2.4}$$

From the definition of market space in *(2.5)*, the demand for a variety i can then be defined as the mass of consumers in i's market space, that is

$$D_i = \int_{S_i} f(\hat{q})\ d\hat{q} \tag{2.5}$$

which corresponds to the mass of consumers in the market segment of

7 Hotelling assumed consumers to be continuously and uniformly distributed over a bounded interval.

variety i.

2.2.1.2. Discrete choice models

An alternative way of dealing with the aggregation problem of heterogeneous consumers is offered by the so called **discrete choice models**, constructed within probabilistic frameworks. Two alternative formulations are possible. A first one assumes that consumers' preferences are not deterministic, and the random nature of the model stems from an individual behaviour which is intrinsically stochastic[8]. Alternatively, it is possible to assume that whilst the individual consumer has well defined deterministic preferences, the firm does not have all the necessary information to model them precisely.

The central assumption of the latter type of models is the non-observability by firms of all the variables which determine consumers' choices. This approach has been more popular with economists because individual choices do not need to be stochastic and could result from a deterministic utility function which reflects preferences satisfying the axioms of **completeness**, **reflexivity** and **transitivity** of neoclassical consumer theory. As a result, the hypothesis of rationality at the individual level can be retained. Firms are only assumed to know the taste distribution over the consumers' space, but they cannot directly observe the idiosyncratic taste parameters. Thus, from the firm's point of view, utility is a **random variable** and each firm can forecast the aggregate demand for its product by attributing probabilities to the event of each consumer choosing that particular

[8] These are briefly discussed in Anderson, de Palma and Thisse (1992c).

variety. Product characteristics and price are the factors the firm can manipulate to affect the choice probabilities and hence the demand for its product.

As before, let there be Z individuals each with a deterministic utility function. However, assume that the firm producing one of the varieties of the product does not know the manner in which differences amongst varieties are perceived and valued by consumers whose tastes are idiosyncratic. The firm only knows with certainty those factors which are perceived in the same way by all potential customers which we represent by means of V_i in equation *(2.2)* above. Given its imperfect knowledge of the utility function of the individual, the best course of action for the firm is to model the individual specific component of the preference structure as stochastic. Hence, the firm will view consumer utility as consisting of two components, one defined over observable characteristics and the other basically a stochastic residual which reflects the unobservable idiosyncratic tastes. Following Anderson and de Palma (1992), the conditional utility function ascribed to the individual consumer by firms over each of the N variants is

$$\tilde{U}_i = V_i + \omega\mu_i \qquad (2.6)$$

where ω is a positive parameter and $\mu_i \sim i.i.d.(0,1)$. Note that ω reflects the degree of subjective taste heterogeneity in the population. Hence, the larger is ω, the larger will be the role of product differentiation - i.e. non-price competition factors - in determining consumers' choice. Consequently, the larger is ω, the less responsive will demand turn out to be to price changes. Also, given that μ_i has been normalized to have zero mean, the element V_i can be seen as the **expected** evaluation of variety i by the Z consumers.

Within this framework, the firm will only be able to model the probability that a given individual will purchase its product. This will be given by the probability that the individual consumer will weakly prefer variety i to all other existing varieties, that is

$$\mathcal{P}_i = Pr\ (U_i = \ max\ \tilde{U}_j) = Pr\ (V_i + \omega\mu_i \geq V_j + \omega\mu_j) \tag{2.7}$$

where $i,j=1,\ldots,N$. Note that the specification used for the random utility in *(2.6)* is additive and linear in prices, income and the random term. Hence, equations *(2.6)* and *(2.7)* define a **linear random utility model** (LRUM). If the choices of the Z individuals are independent, and are governed by the same probability distribution, then the **expected demand** for variety i will be given by

$$E(D_i) = \mathcal{P}_i Z \tag{2.8}$$

where $i=1,\ldots,N$.

There are several ways of specifying the distribution of the random variable μ_i, in order to determine the choice probability. The simplest case is to assume that the random term is uniformly distributed. Alternatively, μ_i may be assumed to be normally distributed as in the **probit** model. The formulation which has received most attention in the product differentiation literature, however, assumes that the random term is **logistically** distributed, given the tractability advantage of the logistic distribution over the normal one (see Anderson, de Palma and Thisse, 1992a,b). For example, the random utility in *(2.6)* is applied to the **multinomial logit model**, where μ_i is *i.i.d.* $(0, \sigma^2)$ according to the double exponential distribution

$$F(b) = Pr(\mu_i \le b) = exp - \left\{ exp - \left((b/\bar{\omega})+\psi\right) \right\} \tag{2.9}$$

where $\bar{\omega} = \omega\, 6^{1/2}/\pi$, b is a positive constant and ψ is Euler's constant[9]. Given *(2.9)*, the following choice probability is derived

$$\mathcal{P}_i = \frac{exp\ [V_i/\bar{\omega}]}{\sum_{j=1}^{N} exp\ [V_j/\bar{\omega}]} \tag{2.10}$$

Note that $\bar{\omega}$ gives the standard deviation of taste heterogeneity over the population of consumers. Note that the larger is $\bar{\omega}$, the greater will be the importance of taste heterogeneity in determining choice probabilities. As $\bar{\omega} \to \infty$, $\mathcal{P}_i \to (1/N)$, and the importance of objective differences in prices and qualities becomes completely irrelevant. Instead, $\bar{\omega} = 0$ corresponds to the homogeneous good case where objective differences are the only determinants of consumers' choice.

It follows, from equations *(2.8)* and *(2.10)*, that the expected aggregate demand for variety i is

$$E(D_i) = Z\, \frac{exp\ [V_i/\bar{\omega}]}{\sum_{j=1}^{N} exp\ [V_j/\bar{\omega}]} \tag{2.11}$$

2.2.1.3. The address approach as a discrete choice model

The address and the discrete choice models described above do not necessarily provide two alternative ways of dealing with the derivation of aggregate demands from individual heterogeneous demand

---

9 See Manski and McFadden (1981) and Anderson, de Palma and Thisse (1992a, b, c) for the full derivation and properties of the logit model. The logit model was first used by de Palma *et al.* (1985) in a model of f.o.b. pricing. See also Anderson and de Palma (1987, 1988) and Anderson, de Palma and Thisse (1988a, 1988b, 1989, 1992a).

functions. Anderson, de Palma and Thisse in a series of papers identify the circumstances under which the two models yield demand systems with identical characteristics[10].

It is not difficult to see the strong similarities between the two models. A deterministic version of the discrete choice model can be obtained by re-writing equation *(2.6)* as

$$U_i = V_i + \omega e_i \qquad (2.13)$$

where the random term has been substituted by an element from a vector $e' = (e_1, \ldots, e_i, \ldots, e_N)$ which describes deterministic tastes and contains consumers' evaluations of the disutility associated with the N varieties. Each consumer will then be associated with a vector of evaluations.

By summing the densities of all points with the same evaluation vectors one can obtain a density function for e. Note that if e_i has the same density function as μ_i - given by equation *(2.9)* - then in the deterministic case, aggregate demand for variety i will be

$$D_i = Z \frac{exp\ [V_i/\bar{\omega}]}{\sum_{j=1}^{N} exp\ [V_j/\bar{\omega}]} \qquad (2.13)$$

whose similarity with *(2.11)* is evident. Clearly, the consumer density function here plays the same role as the probability density function in the logit model.

Anderson, de Palma and Thisse (1992a,c) show that a density

---

10 This is an interesting theoretical development because the possibility to represent probabilistic models in a deterministic framework allows one to explain the randomness of consumer behaviour by referring to the incompleteness of firm's information.

function $\hat{f(q)}$ can be derived such that the demand equation *(2.5)* in the address model is consistent with the one in *(2.10)* obtained from the logit model. The authors demonstrate that for the two approaches to be reconciled the dimension of the characteristic space must be **large enough** compared to the number of existing varieties. If the characteristic space is sufficiently large, the linear random utility model satisfies the following properties (see Anderson, de Palma and Thisse, 1992c, for proofs):

I) $\frac{\partial \mathcal{P}_i}{\partial P_j} \geq 0$ for all $i,j=1,...N,\ j \neq i$. Hence, the varieties of the differentiated product are **weak gross substitutes**.

II) $\frac{\partial \mathcal{P}_i}{\partial P_j} = \frac{\partial \mathcal{P}_j}{\partial P_i}$ for all $i,j=1,...N,\ j \neq i$, which reflects the equality of the cross-price derivatives.

III) $\mathcal{P}_i$ depends only on price differences.

IV) $\lim_{(\gamma_i - P_i) \to \infty} \mathcal{P}_i = 1$ for all $i,=1,...N,\ j \neq i$ and $(\gamma_j - P_j)$ finite. This implies that all consumers choose variety i with certainty when it becomes infinitely attractive in terms of its objective utility, while the measured utility of the other varieties remains finite.

It can be proved that a **sufficient** condition for weak substitutability[11] is that the set $\{q_1,...,q_N\}$ must contain $(N-1)$ independent points, which implies that the characteristic space should be sufficiently large. More precisely, a sufficient condition for weak substitutability is that $M=N-1$[12]. This is consistent with the

[11] As we shall see, weak gross substitutability is a basic feature of models of product differentiation characterized by localized competition.

[12] For several specific models, as for instance the multinomial logit

suggestion by Archibald and Rosenbluth (1975), that if the characteristic space is **large enough** each variety is not subject to neighbouring effects. We shall return to this point shortly, because of its implications for the nature of competition between firms.

Anderson, de Palma and Thisse (1992c) demonstrate[13] that

1) Any system of choice probabilities derived from a discrete choice model of a LRUM form satisfies the above properties.

2) Any system of expected demands which satisfies the above properties can also derived from a system of choice probabilities of the LRUM form.

3) A given location of the N varieties can be found in the characteristic space such that the demand system resulting from the address approach satisfies I)-IV) above. Hence,

4) The logit demand functions can be generated from the consumer utility function in *(2.1)*.

To summarize, the Z statistically independent consumers of the discrete choice model specialize their consumption activity on one single variety of the horizontally differentiated good and, in the logit formulation, they also buy one single unit of the good. Firms do not have full knowledge of the idiosyncratic taste parameters and thus estimate the demand function for their product by constructing choice

---

model, varieties are **strong gross substitutes**, *i.e.* $\frac{\partial \mathcal{P}_i}{\partial P_j}>0$ for all $i,\ j = 1,\dots,N,\quad i\neq j$. A **necessary** condition for strong substitutability is that the number of varieties does not exceed the number of characteristics by more than one, *i.e.* $(M\geq N-1)$.

[13] We do not provide proof for these results here because it would go beyond the aim of this study. See Anderson, de Palma, and Thisse (1992c) for details.

probabilities. In the address model there is a continuum of consumers, each with a preferred variety and with a subjective disutility from not getting it. In the logit model, taste heterogeneity is measured by the standard deviation $\bar{\omega}$ of the random variable μ_i and in the address model it is measured by the parameter α in the deterministic utility function (equation *(2.1)*). As $\bar{\omega} \to \infty$, $\alpha \to \infty$, and as $\bar{\omega} \to 0$, $\alpha \to 0$. In the former case, consumers tend to buy their ideal variety regardless of the objective characteristic of the good, such as prices. In the latter no role is played by product differentiation and all consumers, in both models, will purchase the cheapest variety. This case would coincide with the homogeneous good case.

As we shall see, the relationship highlighted here between the address model and the discrete choice model will turn out to be a useful one in determining the conditions under which the address model and the representative consumer model which is analyzed below yield the same predictions.

2.2.2. The representative consumer approach

The representative consumer approach to product differentiation is based on the idea that aggregate preferences for diversity are embodied in the utility of a representative agent. Hence, the system of demand equations for the different varieties of the horizontally differentiated good is derived from the maximization of a representative consumer's utility function. Preferences are defined over the set of all possible goods and consumers can be seen as having a taste for varieties captured by some parameter in the utility function. The most commonly used utility function in this type of models is the **constant elasticity of substitution** (CES) proposed by Spence (1976) and by Dixit and Stiglitz (1977).

There are some significant differences between the address and the representative consumer approaches to the modelling of tastes diversity. First, and contrary to the former, in the latter the consumer's utility function represents the aggregate preferences of the overall consumer sector. The product space is not explicitly modelled and all the utility function does is to capture **aggregate** preference for diversity. The implication of this is that demand is not obtained, as in the address model, *via* aggregation of individual demands on the basis of a distribution of preferences. A second major difference is that in the representative consumer approach, consumers purchase a combination of all available varieties, whereas taste heterogeneity implies that the choice will consist of a subset (often containing only one element) of different brands. As we shall see, these two points are amongst the major sources of criticism to the representative consumer approach[14]. In the remaining of this sub-section, we shall examine the main features of the representative consumer approach and consider the circumstances under which this approach can be reconciled with the characteristic approach based on tastes heterogeneity.

2.2.2.1. The "love for variety" model

The representative consumer model we choose to analyze is the

[14] Pettengill (1979) and Archibald, Eaton and Lipsey (1986), amongst others have argued that this class of models cannot capture the features of a population of consumers characterized by heterogeneous tastes and purchasing a few or - more often - only one variety of the good.

constant elasticity of substitution (CES) in the version proposed by Dixit and Stiglitz (1977), given its widespread application in the industrial economic literature as well as in many other fields of economics. The direct utility function of the representative consumer is given by

$$\mathcal{U} = D_0^{\,a}\, D^{1-a} \tag{2.14}$$

where $0<a<1$. Let us, for simplicity, consider the following monotonic transformation of *(2.14)*

$$U = D_0^{\,s}\, D \tag{2.15}$$

where $U=(\mathcal{U})^{1/(1-a)}$ and $s=a/(1-a)$ is positive. D_0 is the quantity consumed of the numeraire good, and D is a sub-utility function given by

$$D = \left[\sum_{i=1}^{N} D_i^{\rho}\right]^{1/\rho} \tag{2.16}$$

where $i=1,\dots,N$, ρ is the parameter which captures love for variety, and D_i are the quantities consumed of each of the N varieties of the differentiated good. Finally, we set $0<\rho<1$, the reason for which will become clear later. The larger is ρ the closer substitutes are goods for one another. The sub-utility function D in equation *(2.16)* is separable with convex indifference curves and has the well known implication that preferences are **symmetric**, *i.e.* each variety competes with all others and there are no neighbouring effects. Note that D can be interpreted as a quantity index - over the existing varieties - of the consumption of the differentiated good.

The problem of the representative consumer can be seen as a two-stage budgeting procedure. The first stage will determine the allocation of a given income over the numeraire and the differentiated good. Hence the consumer will maximize *(2.15)* subject to a budget constraint

$$Y = D_0 + PD \tag{2.17}$$

where the price of the numeraire has been normalized to unity, Y is income (measured in terms of the homogeneous good), and P is a price index for the differentiated good defined as

$$P = \left(\sum_{i=1}^{N} P_i^{\rho/(\rho-1)} \right)^{(\rho-1)/\rho} \tag{2.18}$$

The first order conditions for the first stage utility maximization yield

$$D = \frac{1}{1+s} \frac{Y}{P} \tag{2.19}$$

and

$$D_0 = \frac{s}{1+s} Y \tag{2.20}$$

In the second stage the representative consumer will allocate D over the existing N varieties. This will require to maximize *(2.16)* subject to $PD = \sum_{i=1}^{N} P_i D_i$, where P and D are given by equations *(2.18)* and *(2.19)* respectively. The solution to the second stage utility maximization is given by a system of demand equations, one for each of the N varieties of the differentiated good. The demand for variety i will then be

$$D_i = D \left(\frac{P_i}{P} \right)^{1/(\rho-1)} \tag{2.21}$$

which, given equations *(2.18)* and *(2.19)*, can be rewritten as

$$D_i = \frac{Y}{1+s} \frac{P_i^{1/(\rho-1)}}{\sum_{j=1}^{N} P_j^{\rho/(\rho-1)}} \tag{2.22}$$

The demand function in *(2.20)* states that for any given total consumption of the differentiated good, the demand for each variety i depends on its relative price. Note that

$$\frac{\partial ln D_i}{\partial ln P_i} = \frac{-1}{1-\rho} \tag{2.23}$$

from which $\sigma=1/(1-\rho)$ is, in Chamberlin's terminology, the price elasticity of the **dd curve**, *i.e.* the curve relating the demand for each variety to its own price with all the other prices held constant. Also, given that equation *(2.21)* implies that for $i \neq j$

$$\frac{D_i}{D_j} = \left(\frac{P_i}{P_j} \right)^{-1/(1-\rho)} \tag{2.24}$$

it follows that

$$\frac{\partial ln(D_i/D_j)}{\partial ln(P_i/P_j)} = -\ \sigma \tag{2.25}$$

Hence, σ also corresponds to the elasticity of substitution between varieties. It is then obvious that when $\rho=1$, $\sigma=\infty$, *i.e.* there is perfect substitutability between varieties as in the case of a perfectly homogeneous good. Also, $\rho=0$, and hence $\sigma=1$, would rule out the possibility of some D_i being zero, given that it would describe a situation where varieties are very distinct and are consumed in fixed proportions[15]. It follows that as σ falls the degree of substitutability between varieties becomes smaller.

Finally, let

$$S_i = \frac{P_i D_i}{PD} \tag{2.26}$$

be the share of the market served by each variety i[16], which becomes

$$S_i = \frac{P_i^{1/(\rho-1)}}{\sum_{j=1}^{N} P_j^{\rho/(\rho-1)}} \tag{2.27}$$

Equation *(2.27)* clearly states that market shares are only a function of prices (and of the differentiation parameter) and are independent of income. We shall shortly discuss the implications of this point for market structure.

Pettengill (1979) criticizes the Dixit-Stiglitz model on the ground that the real world is characterized by consumers who do not consume **"a bit of every variety"** but often purchase only one variety of the differentiated good. This point is also made by Archibald, Eaton and Lipsey (1986) who argue that *"if we take the notion of a representative consumer literally, then we ignore an important an obvious source of product diversity, diversity in consumers' tastes".* As stressed by Dixit and Stiglitz (1977) however, if the proper aggregation conditions are fulfilled, the sub-utility function D in equation *(2.17)* can be seen as the scaled version of the

---

15 See the original paper by Dixit and Stiglitz (1977) for further discussion of these issues.

16 Given the assumed heterogeneity amongst varieties, the definition of market share adopted here is in terms of value rather than quantity.

representative consumer's utility. This implies that, within this framework, product diversity can either be interpreted as different consumers using different varieties or as each consumer purchasing a diversified bundle of varieties. Hence, in their reply to Pettengil's paper, Dixit and Stiglitz (1979b) argue that a representative consumer who purchases all varieties is not inconsistent with individual consumers who **specialize** their consumption activity over one (or very few) variety.

However, Archibald, Eaton and Lipsey (1986) cast doubt on the possibility of finding a way to aggregate the preferences of individual consumers so as to obtain a representative consumer utility function which is consistent with the Dixit-Stiglitz one. They note that if *"we regard the utility function as an aggregate preference relation, we are forced to ask what the implied restrictions on individual's preferences are"*. These authors suggest that the address or characteristic approach is preferable to the representative consumer model in that it allows for the explicit modelling of idiosyncratic individual behaviours. Moreover, they argue that it is not possible to find a *"specification of the demand primitives in the address branch which could be aggregated to yield well-behaved preferences of a representative consumer"*.

Perloff and Salop (1985) attempt to synthesize, within a probabilistic choice framework, the characteristic approach with that of the constant elasticity of substitution representative consumer. In their model, individuals who face mutually exclusive choices are assumed to maximize a stochastic utility function. The (positive) probability defined on each choice and associated to each individual is used to aggregate individual behaviour and to obtain a representative consumer preference structure which is Chamberlinian in that it satisfies the symmetry condition. Archibald, Eaton and Lipsey, however, regard this attempt as an unsatisfactory way of reconciling the representative consumer model with the - supposedly superior - address one. They base their criticism on the fact that whilst Perloff and Salop do manage to capture the address branch phenomenon, they imply that the characteristic space is consumer specific and not, as one would expect, common to all consumers.

This theoretical debate has led to a considerable body of literature being generated in recent years. In the next two sub-sections we shall analyze how these different approaches can be reconciled.

2.2.2.2. The representative consumer model as a discrete choice model

Despite the fact that the analogy between the address and the discrete choice models is intuitively easier to grasp than that between the latter and the representative consumer model, it is possible to identify circumstances under which the representative consumer model can be reconciled with a discrete choice model. The most convincing contributions in this area are those stemming from the work of Anderson, de Palma and Thisse (1989, 1992a,c). Following a similar line of argument as the one we discussed with respect to the relationship between the address approach and the discrete choice model, these authors demonstrate that there exists a discrete choice model from which the constant elasticity of substitution can be derived. Assume there to be a number Z of identical and independent consumers, each with income $I=Y/Z$ and purchasing one or more units of only one variety of the differentiated good. Let the conditional utility of an **individual consumer** purchasing a variety i be

$$\tilde{U}_i = lnX_i + s\ lnX_0 + \mu_i \qquad (2.28)$$

were μ_i is a random variable with zero mean and X_0 and X_i are the individual consumption of the numeraire and of variety i of the differentiated good respectively. The budget constraint of the consumer in this context will be

$$I = X_0 + P_i X_i \qquad (2.29)$$

Now, maximizing *(2.28)* subject to *(2.29)* yields the **individual** demand equations

$$X_i = \frac{1}{1+s}\frac{I}{P_i} \qquad (2.30)$$

and

$$X_0 = \frac{s}{1+s}\ I \qquad (2.31)$$

These two equations can be substituted into equation *(2.28)* to obtain

$$\tilde{U}_i = (1+s)\ lnI - lnP_i + s\ ln(s) - (1+s)\ ln(1+s) + \mu_i \qquad (2.32)$$

Hence, the probability that a consumer selects variety i will be $\mathcal{P}_i = Pr\{U_i \geq U_j,\ \ j,i = 1,\dots,N,\ \ j \neq i\}$. Assuming that $\mu_i \sim i.i.d.(0,\sigma^2)$ and has the double exponential distribution given by equation *(2.9)*, then the probability of a consumer choosing variety i will be given by

$$\mathcal{P}_i = \frac{exp\ [(-lnP_i+G)/\bar{\omega}]}{\sum_{j=1}^{N} exp\ [(-lnP_i+G)/\bar{\omega}]} = \frac{P_i^{-1/\bar{\omega}}}{\sum_{j=1}^{N} P_j^{-1/\bar{\omega}}} \qquad (2.33)$$

where $G = ((1+s)\ lnI\ -\ (1+s)\ ln(1+s)\ +\ s\ lns)$[17]. As a result, the expected demand for variety i over the population of Z consumers is given by

$$E(D_i) = Z\ X_i\ \mathcal{P}_i = \frac{I}{P_i}\ \frac{Z}{1+s}\ \frac{P_i^{-1/\bar{\omega}}}{\sum_{j=1}^{N} P_j^{-1/\bar{\omega}}} \tag{2.34}$$

Analogously, the expected aggregate demand for the numeraire will be

$$E(D_0) = Z\ X_0 = \frac{s}{1+s}\ I\ Z \tag{2.35}$$

The similarity between the expected demand equations in *(2.34)* and *(2.35)* and those stemming from the constant elasticity of substitution model in equations *(2.20)* and *(2.18)* is obvious. In particular, by substituting aggregate income $Y = Z\ I$ into equations *(2.34)* and *(2.35)* we obtain

$$E(D_i) = \frac{Y}{P_i}\ \frac{1}{1+s}\ \frac{P_i^{-1/\bar{\omega}}}{\sum_{j=1}^{N} P_j^{-1/\bar{\omega}}} = \frac{Y}{1+s}\ \frac{P_i^{-(1+\bar{\omega})/\bar{\omega}}}{\sum_{j=1}^{N} P_j^{-1/\bar{\omega}}} \tag{2.36}$$

and

$$E(D_0) = \frac{s}{1+s}\ Y \tag{2.37}$$

Equation *(2.37)* is clearly identical to equation *(2.18)* and equation *(2.36)* is identical to equation *(2.20)* for $\bar{\omega} = (1-\rho)/\rho$. Hence, the CES preferences can be generated from a population of individuals with idiosyncratic tastes who make discrete choices of varieties.

More generally, the constant elasticity of substitution demand

---

[17] For proof see Anderson, de Palma and Thisse (1992c).

system of equation *(2.36)* satisfies the properties I-IV of the linear random utility model discussed in sub-section 2.1.3. In particular, from equation *(2.22)* it is obvious that $\frac{\partial D_i}{\partial P_j}>0$, *i.e.* the gross substitute property holds, for all prices. Also the $(N-1)$ cross-price elasticities are identical for all varieties. Furthermore, from equation *(2.24)* it is obvious that the Dixit-Stiglitz model also satisfies the property of the linear utility model that the ratio between any two demands is independent of both the number of varieties and the prices for all other varieties. Finally, given the similarity between the two models, $\bar{\omega} \to \infty$ corresponds to $\rho \to 0$ in the representative consumer model, where the same amount will be spent on each variety of the differentiated good. In turn, $\bar{\omega} \to 0$ corresponds to $\rho \to 1$, and all consumer will purchase the cheaper good.

2.2.3. The address and the representative consumer models reconciled

The analysis carried out in sub-section 2.1.3 showed that the address approach can be reconciled with a probabilistic choice model if 1) the characteristic space is sufficiently large relative to the number of existing varieties, *i.e.* it has a dimension $M \geq N-1$ (ensuring strong substitutability), and 2) there are $(N-1)$ independent points in the characteristic space.

Following the work of Anderson, de Palma and Thisse, we also showed in sub-section 2.2.2. that the logit model generates a system of demand equations which are consistent with those obtained from the representative consumer model. Therefore, by transitivity, a reconciliation between the address model and the representative consumer model can be found and the link between the two models can be provided by the choice probability system consistent with the linear random utility model. For the proof of this result, which we omit, the interested reader may refer to the original contributions of these authors.

As we have already stressed these recent theoretical developments have important implications with respect to the debate about the relative merits of these models. The identification of circumstances under which the address and the representative consumer approaches yield equivalent demand systems weakeans the theoretical soundness of arguments pointing at the superiority of one approach over the other. The choice of which model to adopt will to a great extent remain a matter of convenience and will be determined by the more general aims of the study. For instance, if the explicit modelling of the product space is relevant - as, for example, in models of product selection - then the analysis may be more profitably set in an address or characteristic framework.

2.3. THE NATURE OF COMPETITION

Two major approaches can be identified in the literature on product differentiation with respect to the way they deal with competition. These are the Chamberlinian and the Kaldorian approaches. The difference between them depends on whether preferences are assumed to be symmetric or not.

2.3.1. Chamberlinian models of non-localized competition

The Chamberlinian approach assumes that preferences are symmetric. The implication of this hypothesis is that, from the consumer's point of view, there are no neighbouring effects amongst varieties. This, in turn, implies that firms which specialize in the production of the different variants of the differentiated good do not have any direct competitor, but compete with all other firms in the industry. As a result, competition is said to be **non-localized**. Hence, if a new firm introduces a new variety in the market, it will subtract **"small"** shares of the market from each existing incumbent. More generally, if a firm changes its price, the effects of this action will spread equally to all other firms. It also follows that if the number of firms is large, then the impact of a firm's action on its competitors will be negligible.

The symmetry hypothesis is, as we have already mentioned, the discriminating factor as to whether a model is to be defined Chamberlinian or not. Hart (1985a,b) in a series of papers entitled *"in the spirit of Chamberlin"* stresses that a truly Chamberlinian model of product differentiation ought to be characterized by a number of firms sufficiently large so as to ensure that *"each firm is negligible, in the sense that it can ignore its impact on, and hence reaction from, other firms"*[18]. It may be argued, however, that the largeness of the number of firms is not sufficient, in a differentiated product framework, to ensure the absence of inter-firm impacts and feedbacks. Strategic interaction amongst firms can be ruled out if there are no neighbouring effects between firms producing differentiated varieties. In general, the large number of firms may be a necessary, but not a sufficient condition for the absence of

[18] Hart (1985a). Hart mentioned another important point, namely the elimination of long run profit by entry, on which we shall return at length in this work.

neighbouring effects. In **homogeneous good markets**, with perfect information and no transaction costs, the symmetry condition holds by definition. Hence, the largeness of the number of firms is sufficient to ensure the absence of strategic interaction. In a **differentiated product market** the absence of strategic interaction is ruled out either *via* the symmetry of preferences or by the fact that the number of characteristics is large enough compared to the number of varieties. This latter point, first noticed by Archibald and Rosenbluth (1975) and later developed by Anderson, de Palma and Thisse in a series of contributions, implies that a Chamberlinian model does not require to be based on symmetric individual preferences but on symmetric aggregate demand functions. As we saw, when the number of characteristics is large, there is a correspondence between the address and the representative consumer model. Hence, there are models which are consistent with symmetric aggregate demand functions despite the absence of a specifically symmetric preference structure.

Non-localized competition has been obtained in the literature in several ways. In a first class of models, which build on the work of Spence (1976) and Dixit and Stiglitz (1977), symmetry stems from the form of the utility function of the representative consumer. For example, in the Dixit-Stiglitz model described in sub-section 2.2.1., varieties enter the additively separable sub-utility function *(2.16)* with the same functional form (D_i^{ρ}), thus ensuring symmetry of the representative consumer utility function and of the resulting demand equations. Non-localized competition also stems from models which are not developed within the representative consumer framework. Perloff and Salop (1985) use a linear random utility model in which each consumer buys one unit of a chosen variety. Sattinger (1984) develops an additive random utility model which allows for the consumer to purchase a variable amount of the chosen good. In both cases, the individual conditional demands are independent of the realization of the random term. The **expected** aggregate demand for each variety i is of the form $E(D_i) = X_i(P_i)\ Z\ \mathcal{P}_i$ where $X_i(P_i)$ is the individual demand. Clearly, X_i and $\mathcal{P}_i$ are separable. This result stems from the fact that in both models the random term in the consumer's utility function, which - as in equation *(2.6)* - describes the intensity of tastes' heterogeneity, is assumed to be identically and independently distributed. It follows that the observation of the realization of the random variable for a particular variety does not convey any information as to the consumer's evaluation of other varieties. As a result, there are no neighbouring effects between varieties. Hart (1985) provides a generalizations of Sattinger's model where consumers' preferences are only defined over a **sub-set** of brands. It follows that consumers can be seen as having heterogeneous preferences and a density function can be defined which describes the number of consumers who have a taste for any particular variety. Hart assumes that for each consumer any combination of the varieties in his/her subset is equally desirable, so that neighbouring effects are ruled out amongst varieties. Similar results are also obtained by Dierckere (1991)[19]. Recently, von Ungern-Sternberg (1991) has developed a location model of monopolistic competition which allows for multi-firm

[19] In the models by Hart and Dierkere, however, individual demands are a function of the realization of the random term. Hence, the fraction of income spent on the chosen variety is not homogeneous across consumers.

competition by locating producers at the corners of a *"multidimensional pyramid"* with consumers uniformly distributed along the edges of the pyramid.

2.3.2. Kaldorian models of localized competition

The symmetry hypothesis has been criticized by Kaldor (1935) who pointed out that *"any particular producer will always be faced with rivals who are nearer to him, and others who are 'further off'"*. Kaldor continued by suggesting that each producer will be able to subjectively rank his rivals on the basis of the extent to which their price decisions affect his own demand. Kaldor's contribution is at the basis of a class of models characterized by localized competition, whereby each firm competes only with those firms which are closer to it either geographically or in the characteristic space. The non-symmetry assumption is generally associated with address models of product differentiation, with consumers located in the product space at their ideal address and purchasing one unit of the good which gives them the highest indirect utility[20]. For instance, consider a situation where the N varieties of the differentiated product are uniformly distributed around a circle with circumference L. L/N will then be the distance between any two successive varieties. Let consumers' ideal locations $\hat{q}$ be uniformly distributed along the circle, with density Z/L. In this framework, each variety i competes directly only with other two varieties, namely $i-1$ and $i+1$. The market segment S_i held by

[20] See Salop (1979) for a typical example in this tradition. Given each individual's ideal location, Salop assumes linear disutility (or transportation) costs. In Capozza and Van Order (1978) each individual can buy more than one unit of the chosen variety.

a variety i is given by the arc of the product circle whose extremes are represented by the locations of those consumers who are indifferent between variety $i-1$ and i and between i and $i+1$. This means that for any given price structure, if a consumer whose address is at $\hat{q}$ chooses to buy variety i, then all consumers whose location lies between $\hat{q}$ and q_i will find that variety i allows them to reach the highest indirect utility. As a result, whatever the price structure in the industry, a given variety will not be gross substitute for more than two other varieties. The demand for each brand can be determined as the product between the length of the segment S_i and consumer density and will turn out to be a function of the variety's own price and of the prices of the two neighbouring varieties. It follows that, whilst in the case of non-localized competition all varieties are gross substitute, when competition is localized gross substitutability holds only for neighbouring varieties which compete directly[21].

Anderson, de Palma and Thisse (1992c) show that the Kaldorian model can be associated with a linear random utility model by representing the transport cost of the consumer in the former by a vector of evaluations corresponding to a *"set of realizations of the random variable in the probability model"*. This enables them to compare the localized competition model to the non-localized one. Within a probabilistic framework, it emerges that while in the non-localized competition model *à la* Perloff and Salop (1985) consumer's choice can only be predicted on the basis of the observation of the

[21] Swann (1993) provides a framework for identifying competitors networks.

realization of all random variables, in the localized competition model *à la* Salop consumer's behaviour can be predicted on the basis of the realization of at most two random variables.

Recently, Deneckere and Rothschild (1992) have built on these results to develop a linear random utility model of demand of which both the Chamberlinian symmetric model and the localized competition version of the address model are special cases. Individuals are assumed to have different rankings over alternative products, but they derive the same utility from goods which occupy the same position in their respective rankings, hence *"consumers have the same kind of cardinal preferences but their ordinal preferences differ"*. The number of types of consumers is supposed to be equal to the number of distinct permutations of rankings of the number (N^P) of potential varieties and the mass of consumers with the same ranking is the same for all possible rankings. Assuming the existence of a continuum of consumers, Deneckere and Rothschild derive the demand for a variety i by determining the fraction of consumers with preferences of type i. The non-localized competition case can be analyzed in this framework by noting that the complete ranking of a consumer can only be known if his/her evaluations for **all** potential products are known. Hence, by selecting a consumer at random there will be a probability $1/N^P!$ of the consumer belonging to a particular type. In the localized competition case, instead, the type to which a consumer belongs can be determined once his/her most preferred variety is known. In this case the number of possible ranking will be N^P. Deneckere and Rothschild analyze both situations on a circle framework by means of an iterative procedure whereby the number of both potential varieties N^P and consumers is doubled each time, while the number of actual varieties N is held constant. As the number of iterations goes to infinity, both potential varieties and consumers tend to fill the whole circle and thus the localized competition model converges to the non-localized competition one characterized by a uniform distribution around the circle, as in Perloff and Salop (1985).

2.4. TASTE FOR DIFFERENCES AND ECONOMIES OF SCALE

If taste heterogeneity is associated with a situation characterized by the existence of economies of scale in production, then the number of varieties produced will be small in comparison to the number of consumer types. In the absence of economies of scale, one could envisage - as suggested by Eaton and Lipsey (1977) - a "*back-yard capitalism*", with all individuals producing their own ideal variety. Instead, there is a scope for specialization in production as a result of which the market is unlikely to support the number of varieties consistent with the complete consumers' taste range. This has two important consequences. First, there exists a trade-off between the realization of potential scale economies and consumer preferences. Second, firms have some degrees of monopoly power. These two aspects are analyzed below.

2.4.1. Market equilibrium and social optima

On social welfare terms, a commodity should be produced if the difference between gross surplus (sales revenue plus consumer surplus) it generates and the total cost of producing it is positive. Firms, however, produce as long as profits are non-negative, hence this welfare criterion may not be satisfied. Indeed, the existence of increasing returns to scale in production implies that the equilibrium number of varieties may differ from the socially optimal number of brands. Spence (1976) shows that market equilibrium may not sustain the optimal number of varieties and *"too many, too few or the wrong products"* may be produced hence adding to the, traditionally recognized, welfare cost of imperfect competition, *i.e.* the inequality between price and marginal cost. The reason for this lies in the existence of a trade-off between **efficiency** and **varieties** which characterizes differentiated product markets in presence of potential scale economies whose realization requires that quantities as large as possible are produced. However, love for variety implies that *ceteris paribus* the larger the number of firms, the higher is the level of utility attainable by consumers.

In Spence (1976) single product firms who could perfectly price discriminate, *i.e.* charge each consumer a different price, would produce the socially optimum number of varieties, because a new entrant would capture the exact increase of consumer surplus. In the absence of perfect price discrimination, revenues do not capture consumer surplus and even when the social value of the product is positive they may not be sufficiently high to cover production costs. In this sense, **too few** products may be produced. However, another force is at play. The introduction of a new product by a new firm reduces incumbents' demands and profits. If these effects are not taken into account by the new entrant, a new product may be introduced which does not generate a social benefit. In this sense, the market outcome may be characterized by **too many products**.

Economists since Chamberlin's work have actually argued that too many varieties are produced at sub-optimal scales, but theoretical results have not always supported this view. Dixit and Stiglitz (1977) compare market outcomes to first and second best social optima. They show that for the constant elasticity utility function the market equilibrium is identical to the constrained social optimum. When compared to the unconstrained social optimum, market equilibrium is shown to generate the same output but a smaller number of varieties than socially desirable. Hence, their findings go against the widespread idea that **i)** the market under-exploits economies of scale, and **ii)** there is an excessive production of varieties. Note that when considering a variable elasticity, Dixit and Stiglitz do not find unambiguous results but suggest that *"there is a presumption that the market solution would be characterized by too few firms"*. Sattinger's (1984) model, characterized by consumers' specialization in consumption, also leads to the provision of two many or two few products in equilibrium. Hart (1985b) confirms this indeterminacy within a framework where the representative consumer hypothesis has been relaxed. Yarrow (1985) attempts to quantify, with a constant elasticity of substitution utility function, the welfare loss stemming from the market outcome consisting of the wrong number of products. He shows that this loss is relatively small, the reason being that if the market is large the cost involved in producing below the optimum scale of production is small. The welfare loss may be of a different magnitude if the market is small.

In the address model *à la* Salop (1979) the circular market is characterized by too large a number of varieties, but this result is rather model specific, because it crucially depends on the distribution of consumers on the circle. Within a spatial model, Capozza and Van Order (1980) argue that given that the symmetric-zero-profit equilibrium is characterized by too many varieties, an equilibrium where firms earn pure profits may be better from a social welfare point of view. In a model where potential entrants take the location of incumbents as fixed, Eaton and Wooders (1985) confirm the result of an over-production of varieties for a production technology characterized by a constant marginal cost.

These results are confirmed by Denecker and Rothschild (1992) who find that non-localized competition yields approximately the socially optimal number of brands when the fixed cost is sufficiently small compared to the size of the market, whereas localized competition generates an overproduction of varieties. They explain these findings by arguing that competition is higher when it is non-localized than when it is localized.

2.4.2. Taste heterogeneity and monopoly power

The existence of heterogeneous tastes has two important implications: 1) firms producing differentiated commodities have a certain degree of monopoly power, and 2) the market can sustain different prices.

Clearly, consumers are prepared to pay more for those varieties which are closer to their ideal one. To a great extent, the closeness of the existing brands to consumers' ideal product specifications depends on how many of the potentially producible varieties are actually supplied. This, in turn, depends on the extent to which potential economies of scale exist in production. Consumers are willing to pay a premium for varieties closer to their ideal one and price making firms will not lose all their customers if they slightly increase their price. This is because price is not the only variable affecting consumers' choice, the decisive role being played by the subjective way in which differences between varieties are perceived and valued. Hence, a price differential between any two varieties does not necessarily imply that all demand is channeled towards the cheapest one (as in a homogeneous good market with perfect information and no transaction costs). **Changes in relative prices**, however, may generate a revision of consumption selections. This is more likely to happen the smaller is the number of varieties produced and available for consumption relative to the ideal ones. As a result, the smaller is the number of varieties, the more important is the price element in determining the evolution of market shares. This argument can be effectively illustrated within Lancaster's framework and, relying on the result obtained by Anderson, de Palma and Thisse (1989), it can also be easily generalized to encompass the representative consumer approach. Thus, the consumer chooses the variety, amongst those on offer on the market, that is closest to its ideal one. Swann (1993) defines a **territory**, analogous to the market space of the address approach, for each variety as the set of consumers who derive maximum surplus - from a moneymetric utility function, linear in the product's characteristics - from the consumption of that variety. The smaller is the number of varieties, the smaller will be the chance that the consumer finds its ideally preferred one, and the higher the likelihood that his/her choice will be falling at the boundaries of the territory. When the price of a good changes, the consumers who are likely to modify their choice are those closer to the boundaries of the territory. If the price of a product increases, the territory of the product will shrink, due to some boundary consumers revising their choice. The ideal consumer will be the last deserting the product. Conversely, if the price of a variety falls, its territory will expand. Some consumers will move form one boundary area to another. However, only those consumers for whom the change in price is worth (in terms of utility) the shift to a less preferred variety will revise their choice[22]. In the aggregate, for any change in the price structure of the market, there will be a re-distribution of demand across varieties.

It is important to notice at this point that the theoretical literature on product differentiation does not do justice to the two facts stemming from taste heterogeneity we have discussed in this sub-section. Indeed, the great majority of models are built on assumptions which lead to the elimination of price differentials between varieties. Furthermore, the implications of monopoly power for profits are somewhat limited to the short-run equilibrium. These two issues will be analyzed in Sections 2.5 and 2.6 respectively.

2.5. EQUILIBRIUM PRICES

Having discussed the relationship between prices and consumer behaviour, we now turn our attention to the determination of prices.

The major source of difference between models of horizontal

[22] Swann (1992) uses this to offer a method of identifying asymmetric competitor networks.

product differentiation is in the hypotheses underlying the specification of consumer preferences. As a result, the generality of these models is characterized by very similar supply sides which are developed on a few common assumptions. First, there exists some form of economies of scale in production which generate an incentive to specialization so that firms produce one single variety of the good. It follows that there is a one-to-one correspondence between the number of varieties and the number of price-maker firms in the industry. Second, firms are generally players of a non-cooperative game. Given these hypotheses, let

$$C_i = K_i + \beta_i Q_i \tag{2.38}$$

be the total cost function of a firm i, where K_i is the fixed production cost, β_i is the marginal cost and Q_i is output. Each firm offers the quantity Q_i that is demanded at the price it sets, *i.e.* the market for each variety is characterized by the equilibrium condition $Q_i=D_i$[23]. As a result, the profit of firm i will be

$$\Pi_i = (P_i-\beta_i)D_i - K_i \tag{2.39}$$

A price equilibrium will then be represented by a vector of prices $\mathbf{P}^*=(P_1^*,P_2^*,\dots,P_i^*,\dots,P_N^*)$ such that P_i^* maximizes Π_i conditional on P_j^*, $j=1,\dots,N$, $j\neq i$.

As stressed by Waterson (1990) models of horizontal product differentiation are mostly based on a perfectly symmetric framework on the supply side whereby all firms are *"the same but equal"*. Hence, if

---

23 What follows is a general analysis, hence we use D_i to represent demand for the differentiated product regardless of the particular model used to derive it. Note that in the equations which follow the expected demand $E[D_i]$ stemming from a probabilistic framework could be used instead.

firms all have the same costs, equation *(2.39)* can be rewritten as follows

$$\Pi_i = (P_i-\beta)D_i - K \tag{2.40}$$

It follows that the optimal price strategy will result in a symmetric equilibrium in prices, with $P_i^*=P_j^*$ for all $i\neq j$. This also implies that quantities, profits and hence market shares are identical across firms[24].

In Salop's (1986) version of the Hotelling model, for instance, all varieties (and hence firms) are located equidistantly around the circle representing the consumer spectrum of tastes. Hence, all firms will find it optimal to charge the same price $P=P_i$ for all i thus generating a symmetric price equilibrium.

Chamberlinian models, characterized by non-localized competition, always assume that firms are homogeneous in their costs. Consider the demand function resulting from the Dixit-Stiglitz model of equation *(2.21)*. The first order condition for the maximization of the profit function in *(2.40)*, where P_i is the firm's choice variable, is given by

$$P_i= \rho^{-1}\beta = \sigma(\sigma-1)^{-1}\ \beta \tag{2.41}$$

which implies that $P_i=P_j$ for all $i\neq j$. Clearly, the symmetry in equilibrium prices implies symmetry in equilibrium demands, *i.e.* $D_i=D_j$ for all $i\neq j$.

Although, as we saw, a differentiated product market can sustain an asymmetric equilibrium structure of prices, few exceptions to symmetry can be found in the product differentiation literature,

---

24 This is true if no asymmetries are generated on the demand side of the model as - for instance - in Pascoa (1993).

because there are few exceptions to the hypothesis of identical firms on the cost side. Furthermore, models generating asymmetric equilibria have mainly been developed within the address framework of Hotellian tradition. For example, Neven (1986) allows for a non-uniform customers distribution in a duopoly, and Waterson (1990) assumes asymmetric costs of serving consumers with different locations on the taste spectrum.

Other examples of asymmetric equilibria can be found in that strand of the address literature which builds on the idea that relocation is costly. The symmetric localized competition literature implies that as new firms enter the industry incumbents can relocate without incurring in any costs with a resulting new symmetric equilibrium being generated. However, as suggested by Capozza and Van Order (1980) it may be more plausible to assume that firms will not find it costlessly to relocate, *i.e.* to alter the specification of their product, as new firms producing new varieties enter the market. It follows that a new entrant will have to locate in a niche of the market and will be able to attract customers only from two (in the circle model) other firms. But this implies that the profit of the newcomer will be below that of the incumbent. This has two consequences. First, the symmetry of equilibrium will not be ensured. Second, incumbents' profits will not be a precise indication of the profit opportunities of the industry; as a result, entry may stop **before** profits are driven to zero[25].

In the Chamberlinian tradition, but outside the representative

[25] We shall return on this point in Section 6, where the importance of relocation costs in preserving long-run profits is discussed.

consumer framework *à la* Dixit and Stiglitz (1977), asymmetric prices can be found in Hart (1985a) but they are exogenously given and do not stem from different costs. Pascoa (1993) reformulates Hart's model as a non-atomic Bertrand game where an asymmetric equilibrium results from asymmetric demand functions. In von Ungern-Sternberg (1991) firms with different costs are shown to generate an asymmetric equilibrium structure of prices, quantities and profits in an address model which allows for non-localized competition.

Within the representative consumer framework, the determination of equilibrium variables presents significant computational difficulties when different production costs are allowed for, as stressed by von Ungern-Stenberg (1991), and the hypothesis of firms technical homogeneity is generally retained.

2.6. THE EFFECTS OF ENTRY

A major distinction in these models is between the short-run and the long-run. The short-run is defined as the situation where the number of firms *(N)* is fixed. In the long-run new firms are free to enter the market. Two theoretical issues can be related to entry. The first addresses the question of whether the monopolistic competition model converges to perfect competition. The second is related to the effects of entry on long-run profits.

We do not intend to deal with the first issue extensively. As mentioned earlier, Hart (1985a,b) argues that two of the fundamental hypotheses which characterize a model as being Chamberlinian are that each firm should be negligible relative to the market to ignore inter-firm impacts and that free entry should not be limited by set-up costs. Models which relax either of these assumptions are intrinsically oligopolistic and not monopolistically competitive. However, these two features also characterize perfect competition and a theoretical issue arises as to whether circumstances can be identified under which the long-run equilibrium will be perfectly competitive or monopolistically competitive, with price equal to or greater than marginal cost respectively[26].

This issue has been analyzed by several authors, who first formulate models of monopolistic competition and then analyze the impacts on the imperfectly competitive equilibria of a reduction of set up costs and/or a reduction of firms' size relative to the market. Kaldor (1935) and Robinson (1934) argue that indeed the equilibrium does converge to perfect competition when many firms, small compared to market size, operate in the market. Capozza and Van Order (1982) argue that free entry and perfect information do not generate perfectly competitive equilibria, as long as consumers tastes are heterogeneous and there are fixed costs of developing new products. Hart (1985a,b) conclude that perfect competition can be obtained in the limit when consumers have a taste for all potential brands and when the valuation they place on each of these is finite. Furthermore he shows that this conclusion can be reached even without an infinitely large number of firms in the market, the critical factor being the infinitely large number of potential brands. He shows that with his model where consumers have preferences defined over a subset

[26] This issue is obviously related to the so called **"Folk Theorem"** for competitive markets, stating that if firms are small relative to the market then the market solution is approximately competitive (see Novshek, 1980).

of brands, there is no convergence to the perfectly competitive equilibrium. Perloff and Salop (1985) argue that under certain conditions the equilibrium converges to a perfectly competitive one, but this result would not emerge from a situation where some consumers place an infinitely large value on product diversity. De Palma *et al.* (1985) find that if firms are price makers and there is a sufficient degree of taste heterogeneity between consumers, equilibrium prices decrease but do not reach perfectly competitive levels. The reason is that under these circumstances products provided by the new firms are different enough from the existing ones to ensure that some monopoly power for each firm is preserved.

2.6.1. Entry and the elimination of long-run profits

A more significant issue stemming from the horizontal product differentiation literature concerns the effects of free entry on profits. In the majority of these models the long-run is characterized only by normal profits being earned: if there were positive profits new firms would attempt entry into the market. Obviously, in steady-state no firm has an incentive to exit, hence no firm is incurring a loss.

Consider, as an example of models set in the Chamberlinian tradition, the short-run of the Dixit-Stiglitz model with a fixed number of homogeneous firms. Clearly, equation *(2.41)* indicates the existence of a constant markup, with price and marginal cost being multiplicatively related. As σ increases, the equilibrium value of P reduces. This has a clear intuitive explanation. Given the relationship between the elasticity of substitution σ and the parameter capturing love for variety ρ, it is obvious that as σ increases (and so does ρ) varieties become closer substitutes because preferences become less and less different or idiosyncratic. As a result, consumers are prepared to pay less and less for their preferred commodities or for a higher diversification of their consumption bundle. In equation *(2.41)* price is independent of the number of firms. However, all equilibrium prices are identical, *i.e.* $P_i = P_j$ for all $i \neq j$. Hence, the price index of equation *(2.18)* can be rewritten as

$$P = N^{\rho/(\rho-1)} \rho^{-1} \beta = N^{1/(1-\sigma)} \sigma(\sigma-1)^{-1} \beta \qquad (2.42)$$

which enables us to analyze the effects of market structure on equilibrium prices. As entry occurs and the number of firms in the industry increases, other things being equal, the equilibrium price falls. Intuitively, if N gets very large, consumers will find more and more varieties amongst which to spread their consumption or, given the equivalence results amongst models, will be more likely to find a product specification which is closer to their ideal one. Hence, price competition becomes more intense as new firms enter the industry, thus explaining why price is higher in the short-run than in the long-run equilibrium. Also, note that for any given N, comparative static increses of σ would reduce P, thus reflecting an increase in the **fierceness** of price competition[27].

In the standard version of the Chamberlinian model, as long as there are positive profits, new firms will enter the market each subtracting some demand from incumbents and causing their market to

---

27 Recall that σ also represents the price elasticity of demand for the individual variety.

shrink and their price and profit to fall. Entry will continue until profit is driven to zero. By substituting equation *(2.22)*, *(2.41)* and *(2.42)* into the profit function in equation *(2.40)* and solving for N yields the steady-state number of firms, that is

$$N = \left(\frac{Y}{1+s} - \frac{\sigma-1}{\sigma} \right) / K \qquad (2.43)$$

Clearly, N is uniquely determined and is increasing in the income spent on the differentiated good. Moreover, as σ increases the steady-state number of firms falls. A larger elasticity of substitution between varieties, and a lower love for variety, is reflected in a smaller range of varieties being produced.

Qualitatively similar results are found in the non-localized competition models by Sattinger (1984) and Perloff and Salop (1985).

Profits will also be driven to zero within a localized competition framework characterized by symmetric equilibrium where the short-run equilibrium price is higher the higher is the degree of monopoly power enjoyed by firms. The latter will be affected by factors such as the parameter expressing the disutility cost, the circumference of the circle L and the number of firms (assumed to be fixed in the short-run). Clearly, if consumers are uniformly distributed around the circle and firms are equispaced around it, then the larger is L the more distant will firms be from each other. Similarly, for a given L, the larger is the number of firms the closer to each other they will be located and the easier will be for consumers to switch from one good to another. Finally, other things being equal, the higher is the disutility - or, within a spatial analogous, the transport cost - the more loyal will consumers be to the chosen variety[28]. As in the Chamberlinian model, the existence of positive profits in the short-run will attract entry. The distance between firms will reduce and with it the market share held by each product will shrink. It follows that price and profits will fall because, as the circle becomes more crowded, each consumer will find it easier to find product specifications closer to his/her ideal one. Entry will continue until in the long-run only normal profits will be earned.

2.6.2. The persistence of profits

A central element of the majority of horizontal product differentiation models is the tangency between the long-run average cost curve and the downward sloping average revenue curve. Very few exceptions exist in the literature to the imposition of the zero-profit condition. Nevertheless, this hypothesis has not been immune from criticisms.

A first argument against the imposition of the zero-profit condition can be traced back to Kaldor (1935) and is built on the existence of economies of scale and indivisibilities in production. Even if the existence of positive profits does attract entry, there is no reason why the latter should stop when pure profits are zero. Following this line of analysis, some contributions have established the persistence of profits in the long-run, but mainly within Hotelling type models. In particular, the existence of **relocation costs** has been used to explain a long-run equilibrium characterized by

[28] If the disutility parameter were nil, and/or if $L=0$, then this case would fall into the homogeneous case and all firms would charge the price which equals the marginal cost.

a structure of different and non-zero profit rates. Eaton and Lipsey (1978) build on Kaldor's argument within a spatial model where fixed capital is immobile and the set up costs are at least partially sunk. The resulting heavy relocation costs, together with the localized nature of competition, generate the persistence of long-run pure profits which will not be eliminated by either price competition or entry. If there are relocation costs and competition is localized, large incumbents' profits may not represent a sufficient incentive to enter, because entrants do no expect to achieve the same levels of sales and profits as incumbents. Thus, not only will entry affect demand and profits of incumbents asymmetrically, even if the short-run equilibrium is symmetric, but it may stop **before** the elimination of supernormal profits. Capozza and Van Order (1980) support these results by showing the plausibility of positive profits and multiple equilibria stemming from the existence of indivisibility and capital immobilities. Furthermore, they show that capital mobility and a large size of the market relative to the indivisible unit of capital can undermine Kaldor's argument for the persistence of profits. Eaton and Wooders (1985) show the importance of prohibitive relocation costs in preserving long-run profits, where entry is disincentived by the fact that the new firm will have to locate at equal distance between two existing firms and this may trigger a detrimental price response from them.

A second criticism to the imposition of the zero-profit condition is related to the work of Demsetz (1964) who emphasizes that product differentiation is inconsistent with free entry. If the entrant produces a new and different brand, it does not, by definition, enter the production of pre-existing brands, given that the existence of laws and trade marks protecting imitative entry. He states: "*entry via a different brand or product variety analytically is no different than entry into the electricity market to compete with natural gas. Product differentiation undermines the logic of using "free entry" to deduce the familiar zero-profit Chamberlinian equilibrium*", and goes on to argue that the zero-profit condition is a "*hidden assumption, and one which is difficult to reconcile with product differentiation*". Capozza and Van Order (1982) criticize Demsetz's argument on the basis of Lancaster's idea that a good is worth for the characteristics it possesses. Hence, they argue that trade marks cannot be viewed as effective barriers to entry because "*the relevant market is not the market for a specific brand but rather the market for products with similar characteristics*", and characteristics are difficult to patent. However, they conclude that free entry does not necessarily imply the elimination of profits and they suggest that "*some modification of textbook account on the subject is needed*".

An interesting model is offered by Waterson (1990) where firms first chose location and then set prices. Assuming that locational costs are sunk and that some consumers are easier to serve than others, he explains the origin of different firms' efficiencies. Cost advantages are shown to persist over time (due to the existence of sunk costs) and to generate long-run equilibria which are asymmetric in prices, market shares and positive profit rates.

Brand proliferation has also been identified in the literature as an entry deterrence strategy, obviously within address models, where the product space could be explicitly modelled (see Neven, Matutes, Corstjens (1988) as an example). Bonanno (1987) and Neven (1987) show how entry can be deterred by locating a brand strategically rather than introducing new ones. Again this is a theoretical development occurred within the localized competition approach.

Whilst within the localized competition framework there are models which show how significant pure profits can survive in equilibrium, within the Chamberlinian setting the zero-profit long-run equilibrium is the norm. Entry affects profits of incumbents symmetrically because new firms are not required to occupy niches between any particular pair of existing firms. Hence, entry will generate the elimination of long-run profits. As mentioned earlier, Hart (1985a,b), within a Chamberlinian framework which does not rely on the representative consumer, explicitly disagrees with the view that a truly Chamberlinian model is consistent with positive profits and claims that it is one in which *"free entry leads to* zero-profit *of operating firms"*, despite the fact that equilibrium price exceeds marginal cost. Hence, models in which the existence of set-up costs limits rational entry will violate the *"spirit of Chamberlin"* by generating the persistence of profits and by restricting market structure to a limited number of non-negligible firms. Thus, Hart **imposes** the zero-profit condition. A notable exception is offered by Pascoa (1993) who reformulates Hart's model as a non-atomic Bertrand game where an asymmetric spectrum of equilibrium profits results from asymmetric demand functions. In Pascoa's model only marginal firms are very close to making zero profits whereas all non-marginal firms may earn significant profits.

2.7. CONCLUSIONS: THE NEED FOR FURTHER THEORETICAL DEVELOPMENTS

The literature on monopolistic competition and horizontal product differentiation is constantly evolving. However, the majority of the innovative elements have mainly been confined to the address branch of the theory. The strand of the literature based on the representative consumer has remained anchored to very simplifying and limiting assumptions. The results obtained by Anderson, de Palma and Thisse (1989, 1992a,c) in relating the two bodies of literature would seem to suggest that the consequences of these limitations are not too extreme. However, as argued by these authors, there still is a role to be played by the original individual models and their synthesis does not need to be seen as a substitute for these. And in fact in many areas outside the industrial organization literature the discrete choice model has not yet made its appearance and the two approaches in their original formulations are used instead. As we shall see later in greater detail, trade theory has made a significant use of the monopolistic competition model of product differentiation and very often in its representative consumer formulation. Indeed, the representative consumer framework, in particular as modelled by Dixit and Stiglitz, is greatly appealing in every situation in which an explicit specification of the product space is not essential. In its simplicity, the model is extremely tractable. Tractability problems, however, arise if the symmetric cost structure is relaxed and firms are allowed to have different costs. As von Ungern-Sternberg (1992) states, "*among the main advantages of the 'representative consumer' models is the fact that it allows for multi-firm competition. The disadvantage is that it is usually quite difficult to compute firms'* *equilibrium profits. These problems become insurmountable when one allows for firms with different costs".*

Pascoa (1993) points out that Chamberlin himself (1937) argues that under product differentiation there is no free-entry (in the sub-market occupied by each variety) and firms may enjoy positive profits even if they are negligible in size. He writes: *"the well known diagram illustrating a Chamberlinian equilibrium at the tangency of demand and cost curve was regarded by Chamberlin as a mere expository device, valid only in the special case when all firms face the same demand curve".* Not only did Chamberlin stress the fact that supernormal profits may not be eliminated by entry, but he also reckoned that firms operating in the differentiated product market need not to be identical. Instead, heterogeneity is bound to exist amongst firms producing in a differentiated product industry.

In address models and discrete choice models with localized competition where the product space can be explicitly represented, differences amongst firms and the existence of price differentials can result from the choice of product specification by firms. In a framework where the product space is not modelled, heterogeneity can be introduced either by assuming asymmetric utility functions as in Pascoa (1994) or by allowing for different costs. Indeed, as Stigler (1949) suggests, heterogeneity amongst firms is likely to manifest itself in non-uniform costs. However, in most of Chamberlin's analysis and in the subsequent monopolistic competition literature (see Hart 1985a,b) firms are assumed to be identical *for sake of simplicity*. As a result, a symmetric equilibrium in prices and firms' market shares is obtained and in the long-run positive profits are eliminated by entry.

In the next chapter, we shall concentrate on these two related issues: the need to model firms as having heterogeneous technologies and the non-plausibility of the imposition of the zero-profit condition.

Chapter 3

A CHAMBERLINIAN MODEL OF MONOPOLISTIC COMPETITION WITH FIRM-SPECIFIC COSTS[1]

> *"The picture of* [product] *diversity and unsystematism also makes it very likely, if the group contains several firms, that the products be heterogeneous from the technological viewpoint."*
>
> **Stigler, 1949**

3.1. INTRODUCTION

One of the main features of real world industries is heterogeneity amongst competing firms. This heterogeneity stems from several factors, technological differences and product specifications being the most obvious ones. Even when products are very close substitutes and no substantial **objective** differences exist between them, producers intentionally engage in activities aimed at enhancing what consumers **subjectively** perceive as differences amongst goods and sellers, *i.e.* they pursue forms of product differentiation. Also, even when firms employ the same broadly defined technology to produce similar products, they adopt different production techniques and business strategies. This implies that technology is, to some extent, firm-specific. Thus, within a given technological **paradigm** firms using the same input combinations show differences in their production functions (see Dosi et al., 1988). This is because knowledge (and learning) are embodied in people and organizations and firms in the same industry do not have full access to the same

[1] Some parts of this Chapter appear in Montagna (1995a).

technical knowledge. Firm-specific knowledge (and firm-specific technical progress) imply firm-specific economic performance (and firm-specific forms of process and product innovation). Thus, markets consist of firms which produce different goods with different levels of technical efficiency and achieve different profitabilities and market shares.

These asymmetries amongst competitors appear to persist over time and are not automatically eliminated by competitive forces and/or entry. The source of this persistence, as pointed out by Dosi et al. (1988), lies not only in imperfect and asymmetric information, but in the fact that companies are characterized by different knowledge **prior** to information processing so that learning and imitation are not sufficient to eliminate gaps. Thus, firms in an industry can be seen as being spread along a ray reflecting different levels of technical efficiency and types of market performance.

Studies in the recent evolutionary tradition stress the importance of firm-specific organizational routines and the fact that technology is characterized by varying degrees of appropriability. These factors are used to explain a firm's economic performance within an analytical framework which predominantly builds on the role of history in shaping technical gaps between firms (see, amongst others, Nelson and Winters, 1982, and Dosi et al, 1988). However, in general, issues relating to the source - and even existence - of heterogeneity amongst firms have traditionally occupied a relatively minor position in the more orthodox economic literature. Only recently has theoretical work on industrial market structure produced a number of studies which focus attention on the origin and persistence of differences amongst firms operating in the same market. Some contributions stress the role of information asymmetries amongst competitors in generating persistent differences in firms' performances. For instance, Demsetz (1973) ascribes the existence of technological differences between firms to the fact that competitors may lack the knowledge to imitate the technology of the most successful firms in the industry.

More recently, Jovanovic (1982) develops a model of industry evolution where firms' costs are subject to random influences. The industry is perfectly competitive, with homogeneous output and an infinite number of firms. Firms, are subject to productivity shocks which are drawn from a distribution with unknown mean but known variance. The mean is firm-specific and firms learn about their cost efficiency over time, as they operate in the industry. As a result of the cost differences, low cost firms grow and survive while high cost ones shrink and are forced to exit the industry. In the model developed by Lippman and Rumelt (1982) atomistic price taking firms are subject to firm-specific shocks which however do not change through time. All uncertainty, due to the ambiguity as to how efficiencies are obtained (*"uncertain imitability"*), is resolved after entry. Another model of competitive selection with price-taking firms is provided by Hopenhayn (1992). An interesting feature of these models is that, despite their perfectly competitive framework, free-entry does bring about neither the elimination nor the equalization of supernormal profits in the long-run industry equilibrium. Due to asymmetries in costs, competition leads to the selection of the more efficient firms which survive at the expense of the less efficient ones. So, in Lippman and Rumelt (1982) uncertain imitability and stable inter-firm cost differences lead to limited entry and to stable inter-firm differences in profitability associated with steady-state supernormal profits. Jovanovic (1982) finds a positive correlation between firms' efficiency, concentration and profitability with the steady-state being characterized by a dispersion of positive profit rates. Persistence and heterogeneity of profit margins characterizing the long-run industry equilibrium in perfectly competitive models also results - for example in Lippman et al. (1991) - from demand uncertainty. These studies are carried out within a perfectly competitive framework, where goods are homogeneous and firms face the same market price.

Within the Chamberlinian tradition, Chamberlin himself was also concerned with the relevance of modeling technical differences between firms. In his original work (1933), he stresses that heterogeneity is bound to exist amongst the firms producing different varieties of a differentiated product. The market for each variety is characterized by unique conditions so that the industry consists of a network of related, but to some extent isolated, markets. As a result, the market is likely to exhibit a heterogeneity of prices and wide output and profit ranges. However, as discussed in the previous chapter, in most of Chamberlin's analysis firms are assumed to be identical *"for sake of simplicity"* and this assumption is generally followed by the subsequent monopolistic competition literature[2]. Analytical tractability is certainly one of the reasons behind the uniformity assumption. As stressed by von Ungern-Sternberg (1991)

[2] See Beath and Katsoulacos (1991) and Hart (1985a,b).

allowing for different costs introduces remarkable computational difficulties[3]. However, it is possible to envisage other - more deeply rooted - motivations, related to the dominant vision of the Chamberlinian model. For instance, the uniformity hypothesis can be seen as a device functional to the need to impose the zero profit condition. As recognized by Stigler (1949), allowing for cost and/or demand diversity may be *"devastating: there may be monopoly profits throughout the group at equilibrium"*. Hence, uniformity of costs and demand across firms has been maintained as one of the basic assumptions of models within the Chamberlinian tradition and the main implication of this is that a symmetric equilibrium in prices and firms' market shares is obtained.

This chapter develops a representative consumer model of horizontal product differentiation which, whilst retaining the uniformity assumption on the demand side[4], allows for technical diversity amongst firms. The analysis, set in a partial equilibrium framework and based on closed form equations, offers a particular extension of the Dixit-Stiglitz (1977) model. As in the latter, all consumers are assumed to be identical in tastes and income and no explicit representation is offered of the product space. Production costs, however, are firm-specific. Technical differences between firms are assumed to be generated by a random process. No form of technical progress is incorporated into the model, the emphasis only being on the existence of **persistent efficiency gaps** between firms.

---

3 See von Ungern-Sternberg (1991) who suggests an alternative model of multi-firm competition.

4 See Pascoa (1993) as an example of asymmetries in demand.

These gaps are fixed and not eliminated by competition and/or entry; instead, they are originated once and for all at the moment of entry, as if reflecting an element of **historical accident** determining the efficiency of a firm which shapes its future development and performance. Market structure is determined endogenously *via* entry and exit of firms into the industry. The results of the exercise show that the hypothesis of firms' technical heterogeneity significantly affects the prediction of the standard monopolistic competition model. In particular, the hypothesis of inter-firm cost heterogeneity allows for the **endogenization of the steady-state level of technical efficiency** of the industry which will turn out to be a function of the parameters which determine the extent of price competition. As in the models of competitive selection mentioned above, the hypothesis of asymmetric firms leads to an enhancement of the industry productive efficiency *via* competition. A relationship between industry efficiency, concentration and profitability will emerge which is not always consistent with that stemming from the homogeneous firms monopolistic competition model. Furthermore, cost asymmetries together with the uncertainty as to the efficiency potential entrants will obtain imply that entry does neither eliminate nor equalize long-run profits[5]. Instead, the steady-state is characterized by a spectrum of quantities, prices and profit rates.

---

[5] As emphasized in Chapter 2, this is result is not common in the Chamberlinian strand of the product differentiation literature, although the persistence of profits in the long-run has recently been obtained by by Pascoa (1993) by means of asymmetric demands.

3.2. THE MODEL

We carry out a partial equilibrium analysis, based on closed form equations, of an industry in which products are horizontally differentiated. The demand side of the model relies on the representative consumer approach. On the supply side, firms specialize in the production of one single variety of the differentiated good, given a production technology characterized by decreasing average costs.

3.2.1. The representative consumer

When products are horizontally differentiated, consumers' choice does not only depend on price but on all those elements - such as product specification - concerning the basis on which it is possible to distinguish between goods. As a result, in the general case, the firm's choice is a price/quality mix. Price adjustment could in fact be a relatively unimportant phase of the whole competitive process with non-price factors being more important than price in determining the way in which consumers are paired with sellers.

This model, however, only focuses on the price decision of the firm. Given that the emphasis is on the nature of the competitive process between firms with different production costs, we shall not offer any explicit representation of the product space and a given quality structure will be assumed to exist in the industry. Consumers are assumed to be identical in tastes and income and the model is based on the representative consumer approach. Preferences are characterized by the Dixit-Stiglitz (1977) utility function, which expresses love for variety, namely

$$U = \left(\sum_{i=1}^{N} D_i^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)} \qquad (3.1)$$

where - as discussed in the previous Chapter - N is the number of existing varieties, D_i is the consumption of variety i and $\sigma>1$ is the elasticity of substitution between varieties. This utility function implies that preferences are symmetric, so that neighbouring effects between varieties are ruled out and firms do not have any direct competitors. Although this is a strong simplification, it can be justified, as in Archibald and Rosenbluth (1975), by arguing that neighbouring effects are not likely to be significant if the dimension of the characteristics space is large. Assuming that the proper aggregation conditions are fulfilled, this utility function can also be seen as the scaled version of the representative consumer utility (see Dixit and Stiglitz, 1977). Product diversity can then be interpreted either as different consumers using different varieties or as diversification on the part of each consumer.

The representative consumer's budget constraint is given by

$$P\ D = \sum_{i=1}^{N} P_i D_i \qquad (3.2)$$

where P_i is the price of variety i, D is the total consumption of the differentiated good, and the price index P is defined as follows

$$P = \left(\frac{1}{N} \sum_{i=1}^{N} P_i^{1-\sigma} \right)^{1/(1-\sigma)} \qquad (3.3)$$

Note that the price index adopted here[6] is different from the one often used in this literature and given by equation *(2.18)*. The choice of price index is discussed in Appendix 3.1.

The representative consumer will maximize *(3.1)* subject to the budget constraint *(3.2)*. The solution to this optimization problem leads to the following demand function for each variety i

$$D_i = \frac{D}{N} P^{\sigma} P_i^{-\sigma} \tag{3.4}$$

Equation *(3.4)* says that for any given overall consumption of the differentiated good and a given number of available varieties, the demand for each existing variety i depends on its relative price. Note that σ represents both the elasticity of substitution between varieties and the own price elasticity of each variety, when P is regarded as fixed.

Given the partial equilibrium nature of the analysis, it is not essential to specify the process through which D is determined. For simplicity we shall assume that the industry's aggregate demand is given by

$$D = A\ P^{-\eta} \tag{3.5}$$

where A is a positive constant reflecting a scaled measure of nominal income and η is the price elasticity of demand. This hypothesis relates the total expenditure on the horizontally differentiated good to a measure of nominal income which, as in Hart (1985a) and Pascoa (1993), is not affected by producers' profits, given the partial

---

6 This price index is commonly used in micro-founded macroeconomic models. See, for instance, Weitzman (1985) and Startz (1989) for a use of this specification within monopolistically competitive frameworks.

equilibrium framework. For behavioural plausibility, however, we assume that $\eta<\sigma$. That is, the price elasticity of demand for the differentiated commodity as a whole is smaller than that for the individual variety. Thus, by substituting *(3.5)* into *(3.4)*, the demand function for each variety can be rewritten as

$$D_i = \frac{A}{N} P^{\sigma-\eta} P_i^{-\sigma} \tag{3.6}$$

It may be relevant at this point to anticipate that the cost structure of the industry affects demand both *via* the industry price index P and *via* N since, as we shall show, the number of varieties N depends at any moment in time on the factors determining the industry price structure.

Using equation *(3.6)*, expenditure on variety i of the differentiated product is given by

$$P_i D_i = \frac{A}{N} P^{\sigma-\eta} P_i^{1-\sigma} \tag{3.7}$$

and its market share, in terms of value, is

$$S_i = \frac{P_i D_i}{P\ D} = \frac{1}{N} P^{\sigma-1} P_i^{1-\sigma} \tag{3.8}$$

Thus, the market share of each variety depends on the number of varieties and on the respective relative price. Equation *(3.8)* reflects a major feature of the demand for horizontally differentiated goods, namely that the price factor affects consumer's choice but does not uniquely determine it. As pointed out by Chamberlin, the decisive role is played by the preference structure of the individual which reflects the way in which differences between varieties are perceived and valued. It follows that the existence of a price differential between any two varieties does not necessarily imply that all demand is channeled towards the cheapest one. *Ceteris paribus*, **changes** in relative prices may generate revisions of consumers' consumption selections. Thus, the structure of demand in a differentiated product market can sustain differences in prices amongst varieties. Hence, given that the main implication of tastes heterogeneity is that consumers are prepared to pay more for varieties they like better, tastes heterogeneity can be seen as the source of market power. However, as stressed before, in the monopolistic competition literature differences in prices are generally ruled out *a priori*, because firms are assumed to be identical, with identical cost structures.

3.2.2. The production technology

Technology is regarded as the only source of difference amongst firms. A very simple specification of technology is adopted. Similar to what is usually assumed in this literature, for a representative firm i the total cost function is given by

$$C_i = \beta_i \, Q_i + K \qquad (3.9)$$

where C_i denotes the total cost, β_i is the marginal cost, Q_i is the level of output and K is the fixed production cost. Given the presence of a fixed production cost, equation *(3.9)* reflects the existence of static increasing returns to scale in production. Hence, it can plausibly be assumed that each firm has an incentive to specialize in the production of one single variety of the differentiated product. As a result, there is a one-to-one correspondence between the number of varieties available for consumption and the number of firms in the market[7].

As in the literature surveyed in Chapter 2, the fixed cost K is assumed to be identical across firms. However, the marginal cost is here assumed to be firm-specific and will represent the source of firms' heterogeneity. The higher the value of β, the lower is the firm's efficiency. Each firm in the industry is paired with a value of β randomly drawn from a continuous uniform distribution, described in Figure 1 below, defined over the interval $\left[1-\delta,\ 1+\delta\right]$, with $0<\delta<1$. Note that δ defines the width of the distribution and represents the degree of technical heterogeneity amongst firms. For $\delta=0$, this model collapses into the standard one where the different varieties of the good are produced at the same cost by technically homogeneous firms.

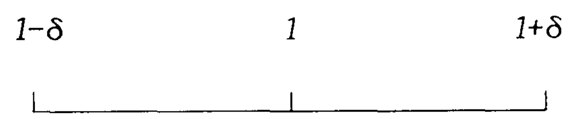

Figure 3.1 The marginal cost distribution

3.3. MARKET EQUILIBRIUM: THE NO-ENTRY CASE

In this section, the possibility of entry of new firms into the industry is ruled out. The industry is assumed to consist of a group of firms **already** paired with given values of β. Given the production technology, the profit function of firm i is

$$\Pi_i = P_iQ_i - \beta_iQ_i - K \tag{3.10}$$

The existence of equilibrium in the (sub)market for each variety

[7] Note that the one-to-one correspondence between number of firms and varieties implies that, for any given N, equation *(3.8)* represents the market share held by firm i.

implies

$$Q_i = D_i \tag{3.11}$$

Assuming that firms engage in a Bertrand game, with P_i as the firm's choice variable, the optimization problem of the representative firm is to maximize the profit function in *(3.10)* which, given equations *(3.6)* and *(3.11)*, can be rewritten as

$$\Pi_i = \frac{A}{N} P^{\sigma-\eta} P_i^{-\sigma} \left(P_i - \beta_i\right) - K \tag{3.12}$$

The monopolistic competition literature implicitly assumes that the firm believes that changes in its own price do not affect the industry price index, *i.e.* $(\partial P/\partial P_i)=0$. This hypothesis is retained here. Accordingly, the number of firms characterizing any given market structure will be assumed to be large enough to induce each firm to believe it will not significantly affect the price index. Thus, the solution to the firm's optimization problem will be given by the following price rule which - given Bertrand conjectures - will define the Nash equilibrium

$$P_i = \frac{\sigma}{\sigma - 1} \beta_i \tag{3.13}$$

Hence, the price of each variety is proportional to the marginal cost of producing it. Given that there is a distribution of firms over the range of the parameter β, equation *(3.13)* suggests that there will exist a corresponding distribution of different prices. The differentiated nature of the product implies that this spectrum of prices will be sustained by demand. Thus, the market will be characterized by an asymmetric equilibrium with a **structure** of equilibrium prices, one for each variety. Correspondingly, an equilibrium dispersion of quantities demanded exists and is given by

$$D_i = \frac{A}{N} \left(\frac{\sigma}{\sigma - 1}\right)^{-\sigma} P^{\sigma-\eta} \beta_i^{-\sigma} \tag{3.14}$$

These generate an equilibrium spectrum of profits, distributed according to the values of β associated with firms in the market, as follows

$$\Pi_i = \frac{\varphi A}{N} P^{\sigma-\eta} \beta_i^{1-\sigma} - K \tag{3.15}$$

where $\varphi=(\sigma-1)^{\sigma-1}\sigma^{-\sigma}$. Thus, lower values of β will correspond to lower prices and to higher quantities and profit margins. The distribution of the values of the parameter β across firms determines the differences in their market performance which is reflected in their market share,

$$\begin{aligned} S_i &= \frac{1}{N} P^{\sigma-1} \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \beta_i^{1-\sigma} \\ &= \frac{\beta_i^{1-\sigma}}{\sum_{i=1}^{N} \beta_i^{1-\sigma}} \end{aligned} \tag{3.16}$$

which, given equation *(3.3)*, can be obtained from equations *(3.8)* and *(3.13)* and suggests that the smaller the firm's own parameter relative to the industry's average, the bigger will be the firm's market share.

Finally, it should be noticed that the larger the number of firms in the industry, the smaller will be, *ceteris paribus*, the output and the profit of each firm. Thus, given the fact that N affects profitability, we must assume that for a given N all firms operating in the industry must find it economically efficient to produce. This profitability condition can be expressed as

$$\Pi_i = \frac{\varphi A}{N} P^{\sigma-\eta} \beta_i^{1-\sigma} - K \geq 0 \tag{3.17}$$

In general, for any given $N=N^*$, there will be a level of efficiency $\beta=\beta^*$ such that $\Pi_i(\beta^*, N^*)=0$. Thus, β^* will be the industry **efficiency cut-off-point,** which determines the minimum level of efficiency compatible with non-negative profits for any given N^*. Those firms whose $\beta_i=\beta^*$ are defined as **marginal firms**; the remaining intra-marginal firms have $\beta_i<\beta^*$ and whose $\Pi_i>0$. See Figure 2 below.

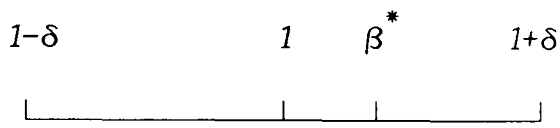

Figure 3.2 The efficiency cut-off point

The simple exercise carried out in this section explicitly models an insight contained in the original work by Chamberlin and captures an important feature of the real world, namely the existence of differences between firms operating in the same industry. We have shown that profits are positive for all firms but the marginal ones and that there is a spectrum of profits and prices characterizing the (asymmetric) equilibrium. This analysis, however, consists of what is traditionally referred to as the short-run or small group version of the monopolistic competition model where the number of firms in the industry is assumed to be given and constant. What happens if entry into the industry is allowed for? This is examined in the next section.

3.4. ENTRY AND COMPETITIVE SELECTION

In this section market structure is determined endogenously *via* entry and exit of firms into the industry. According to the traditional version of monopolistic competition model the entry process leads to the elimination of supernormal profits. We shall argue here that due to the existence of persistent differences in technical efficiencies between firms and to the uncertainty surrounding the size of the marginal cost of potential entrants, rational entry will come to a halt before the elimination and/or the equalization of supernormal profits. Thus, this framework offers one of the possible theoretical explanations for Kaldor's (1935) conjecture that there is no *a priori* reason why entry should stop right at the point at which all profit is eliminated.

Allowing for entry and exit changes the nature of the model, making it intrinsically dynamic. However, a number of behavioural assumptions will be made which allow one to retain the static features of the model.

3.4.1. The exit decision

Incumbents will be assumed to form static expectations about the future structure of the market and take the number of firms operating in the industry as constant over time. As a result, the firm's optimization problem remains a static one. This also explains the lack of time subscripts in the analysis that follows.

From the discussion carried out in the previous sections, it is clear that the industry will be characterized at any moment in time by a certain number of operating firms and by an associated minimum level of efficiency, N^* and β^* respectively. The profitability condition defined in equation *(3.17)* above now becomes the **stay-in-**

the-market condition on which the exit decision is based. Firms will continue to operate in the market as long as their profit is non-negative.

3.4.2. The entry decision

Entry into the industry is modeled on the basis of the following assumptions. First, consistently with what is commonly assumed in the monopolistic competition literature, there exists a very large group of potential entrants. That is, there is no limit to the number of potential varieties of the differentiated good which can be produced. Second, all prospective entrants face the same ex-ante uncertainty as to the level of technical efficiency they will have. All uncertainty, however, disappears once the value of its marginal cost *(β)* is revealed to the firm. Third, β is drawn from the random distribution only after an entry cost has been paid for. Fourth, the entry cost will be assumed to consist of the fixed production cost *(K)* of the first period. The implication of this hypothesis is the absence of any sunk cost associated with entry for any firm whose entry attempt succeeds. K, instead, will be a sunk cost for those firms whose entry attempt fails. The success of entry will be determined by the position of the entrant's β with respect to the industry's cut-off point β^*, at the time of entry. Entry will be successful for those firms whose $\beta_i \leq \beta^*$ at the time of entry. If the draw from the distribution is such that $\beta_i > \beta^*$, the firm will withdraw, thus forfeiting the amount of the first period's fixed production cost. We shall also assume that those firms whose entry attempt fails will not re-attempt to enter the market. This hypothesis is meant to rule out the possibility of there being at any moment in time firms in the industry with the economic burden of sunk costs from previous entry attempts[8]. Finally, at any moment in time, the number of firms in the market is assumed to be sufficiently large for each potential entrant to think it will not significantly affect market structure and, through it, the magnitude of the efficiency cut-off-point. This hypothesis also allows us to treat the number of firms as a continuous variable, thus ruling out the integer problem.

Each entrant will base its entry attempt on the following condition

$$V^E = \int_{1-\delta}^{1+\delta} \Pi(\beta,N^*)\; f(\beta)\; d\beta \geq 0 \tag{3.18}$$

where V^E is the expected profit of the potential entrant, $\Pi(\beta,N^*)$ is as in equation *(3.15)* and $f(\beta)=1/(2\delta)$ is the density function of the random variable β. Note that, given that β_is are drawn independently, the expected profit of the potential entrant is the same for all firms attempting entry at the same time. Firms will have an incentive in trying to enter the industry as long as the expected profit of entry is non-negative. As entry takes place, the demand for each variety will *ceteris paribus* fall. The resulting reduction in revenue will force the marginal firms to exit, hence increasing the average efficiency of the industry and lowering the industry price index *(P)*. The fall in P will raise each firm's demand and induce entry through an increase in the expected profit of a potential entrant *(V^E)*. Thus,

8 The role of this assumption will become clear later, when we analyze the welfare implications of this model.

a complex entry and exit dynamics sets in as one allows for market structure to be determined endogenously.

3.4.3. The steady-state

Entry, however, will not continue indefinitely, but it will come to a halt when the expected profit of an additional entrant becomes negative. The free-entry industry equilibrium occurs when entry stops and hence market structure no longer changes because no firm has an incentive to attempt entry and no incumbent is forced to leave the market. Indicating the steady-state variables with a double asterisk, N^{**} and β^{**} will be the number of firms and the minimum efficiency level characterizing the long-run equilibrium market structure. At these values, the expected profit of any potential entrant is zero and marginal firms will be making zero profits. Hence the two conditions defining the steady-state are

$$V^E(N^{**}) = \int_{1-\delta}^{1+\delta} \left[\frac{\varphi A}{N^{**}} P^{\sigma-\eta} \beta^{1-\sigma} - K \right] f(\beta)\, d\beta = 0 \tag{3.19}$$

and

$$\Pi(N^{**},\beta^{**}) = \frac{\varphi A}{N^{**}} P^{\sigma-\eta} \beta^{**1-\sigma} - K = 0 \tag{3.20}$$

which can be shown to determine N^{**} and β^{**}. Solving *(3.19)* yields the steady-state number of firms

$$N^{**} = \frac{1}{2\delta} \frac{\varphi A}{K} P^{**\sigma-\eta} \frac{1}{2-\sigma} \left(\left(1+\delta\right)^{2-\sigma} - \left(1-\delta\right)^{2-\sigma} \right) \tag{3.21}$$

where, from equation *(3.3)*, P^{**} can be seen to depend on β^{**} as follows

$$P^{**} = \left(\frac{1}{N^{**}}\right)^{\frac{1}{1-\sigma}} \frac{\sigma}{(\sigma-1)} \left(\frac{N^{**}}{\beta^{**}-1+\delta} \int_{1-\delta}^{\beta^{**}} \beta_i^{1-\sigma} d\beta\right)^{\frac{1}{1-\sigma}} \tag{3.22}$$

which, in turn, becomes

$$P^{**} = \frac{\sigma}{(\sigma-1)} \left(\frac{\beta^{**2-\sigma}-(1-\delta)^{2-\sigma}}{(2-\sigma)(\beta^{**}-1+\delta)}\right)^{\frac{1}{1-\sigma}} \tag{3.23}$$

Clearly, the steady-state price index reflects the industry' level of efficiency. Finally, substituting *(3.21)* into *(3.20)* and solving for β^{**} gives the steady-state industry cut-off point

$$\beta^{**} = \left(\frac{1}{2\delta} \frac{1}{2-\sigma} \left[\left(1+\delta\right)^{2-\sigma} - \left(1-\delta\right)^{2-\sigma}\right]\right)^{\frac{1}{1-\sigma}} \tag{3.24}$$

It can be proved that $1-\delta<\beta^{**}<1$ holds for all $\sigma>1$ and $0<\delta<1$. Note that β is distributed with a unit mean. Thus, a sufficient condition for entry to take place is that a potential entrant's expected efficiency ought not to fall below the minimum efficiency (β^{*}) required to be profitable given market conditions.

Note that the significance of equation *(3.24)* is that it gives the endogenously determined level of steady-state efficiency of the industry. In fact in this model, the steady-state industry efficiency stems from the entry and exit process and, as will be discussed more extensively later, is the result of competition between firms.

3.5. COST HETEROGENEITY AND EFFICIENCY

This section brings out the most significant implications of the hypothesis of firm-specific costs for the steady-state features of the monopolistic competition model. Given the tedious nature of some of the expressions, numerical methods are employed to analyze their comparative static properties. The following parameters intervals have been analyzed: $\delta=(0.05, 0.1,...,0.95)$, $\sigma=(1.1, 1.3,...,6.1)$, $\eta=(0.1, 0.3,...,1.5)$[9].

3.5.1. The persistence of profits

For any given values of δ and σ, the steady-state industry will be characterized by a spectrum of efficiencies defined over the interval $[1-\delta,\beta^{**}]$. Thus, surviving firms are distributed uniformly with density function

$$g(\beta) = \frac{1}{\beta^{**}-1+\delta} \tag{3.25}$$

Proposition 3.1: Technical asymmetry among firms and uncertainty as to prospective entrants' efficiencies imply that entry does neither eliminate nor equalize long-run profits.

The persistence of supernormal profits can be illustrated by the expected surplus profit of a surviving firm, that is

[9] Clearly, $\eta<\sigma$ has always been imposed in all cases considered.

$$R^{**} = \int_{1-\delta}^{\beta^{**}} \Pi(\beta,N^{**})\ g(\beta)\ d\beta$$

$$= K\left[\frac{\varphi A}{N^{**}}\ P^{**\sigma-\eta}\ \frac{\beta^{**2-\sigma}-(1-\delta)^{2-\sigma}}{(2-\sigma)\ (\beta^{**}-1+\delta)} - 1\right] \qquad (3.26)$$

which, given the steady state value of N^{**} from equation *(3.21)*, yields

$$R^{**} = K\left[\frac{2\delta}{\beta^{**}-1+\delta}\ \frac{\beta^{**2-\sigma} - (1-\delta)^{2-\sigma}}{(1+\delta)^{2-\sigma} - (1-\delta)^{2-\sigma}} - 1\right] \qquad (3.27)$$

Equation *(3.27)* indicates that the expected surplus profit in steady-state is positive for all $0<\delta<1$ and $\sigma>1$ (R^{**} is plotted in Figure 3.3). Thus, in contrast to the traditional version of the monopolistic competition model, entry does not eliminate long-run profit. Instead, the steady-state will be characterized by a **dispersion** of prices, quantities and positive profit rates which will be distributed over the interval $[1-\delta,\ \beta^{**}]$, with the more efficient firms having higher profits. Let us define a firm *i*'s steady-state profit margin (M_i) as the ratio between its surplus profits and its revenue; from equations *(3.13)* to *(3.15)* we obtain

$$M_i(\beta_i) = \sigma^{-1} - \frac{K}{A}\ N^{**} \left(\frac{\sigma}{\sigma - 1}\right)^{\sigma-1} P^{**\eta-\sigma}\ \beta_i^{\sigma-1} \qquad (3.28)$$

Note that given that $\Pi(\beta^{**})=0$, $M_i(\beta^{**})=0$. Also, given equations *(3.21)* and *(3.24)*[10]

[10] Note that given equations *(3.21)* and *(3.24)*, equation *(3.28)* can be written as $M_i(\beta_i)=\sigma^{-1}(1-(\beta_i/\beta^{**})^{\sigma-1})$.

$$M_i(1-\delta) = \sigma^{-1} - \frac{K}{A} N^{**} \left(\frac{\sigma}{\sigma - 1}\right)^{\sigma-1} P^{**\eta-\sigma} (1-\delta)^{\sigma-1}$$

$$= \sigma^{-1}\left(1 - \left((1-\delta)/\beta^{**}\right)^{\sigma-1}\right) > 0 \qquad (3.29)$$

Thus, $M_i(\beta^{**})$ and $M_i(1-\delta)$ determine the minimum and the maximum values assumed by the profit margins of firms in the industry steady-state. In fact,

$$\frac{dM_i}{d\beta_i} = -\sigma^{-1}(\sigma-1)\,\beta^{**1-\sigma}\,\beta_i^{\sigma-2} \qquad (3.30)$$

which is negative for any values of σ and δ. Hence, M_i is monotonically decreasing in β_i which means that higher efficiency firms will enjoy higher profit margins. As is clear from equation *(3.8)*, given that S_i is also decreasing in β_i, more efficient firms will enjoy larger market shares in terms of value.

3.5.2. Competition and endogenous efficiency

As was mentioned, one of the most significant implications of allowing for cost heterogeneity in the monopolistic competition model is the **endogenization of efficiency**. The idea that competition fosters efficiency is widespread in the literature, but no unique interpretation of the underlying mechanism linking the two emerges from it. In a static sense, competition is supposed to benefit efficiency *via* its role in reducing the price-cost margin and, through it, monopoly power. Note that in this context competition does not affect technical efficiency. Technical efficiency is explicitly dealt with by two other strands of the literature. A first approach underlines the role of competition in generating incentives to innovate[11]. Another channel is provided by the existence of inter-firm cost differences in whose presence competition selects efficient production organizations which will survive and prosper at the expense of less efficient ones. Thus, competition affects the average technical efficiency of the industry.

The steady-state market structure, described by β^{**} and N^{**}, depends on σ and δ.

> **Proposition 3.2**: A higher degree of heterogeneity amongst firms *(δ)* and a larger price elasticity of demand for the individual variety *(σ)* lead to a higher minimum efficiency required to survive in the steady-state, and to a higher average industry efficiency.

As can be seen from Figure 3.4, β^{**} is a decreasing function of both δ and σ. In turn, the lower is β^{**}, the higher is the average efficiency of the industry. The impact of σ and δ on the efficiency cut-off point can be intuitively explained by considering that these parameters can be interpreted as the main determinants of the **toughness of price competition**[12]. The size of σ reflects the importance of price relative to non-price competition, with higher values of σ implying higher substitutability between varieties and hence a less significant role of product specification in determining consumer's choice. As the extent to which competition relies on price performance rises, firms will have to be more efficient in order to be profitable. Moreover, *ceteris paribus*, price competition will be

---

11 This and other strands of the literature are surveyed by Vickers (1995).

12 This concept is used here in a fashion similar to that adopted by Sutton (1992).

more fierce the larger is the efficiency gap between the most and the least efficient firms (determined by the size of δ). Clearly, given the entry and exit process whereby more efficient entrants displace less efficient incumbents, the higher is the variability in technical efficiencies, the more efficient will be the average firm surviving the industry dynamics and operating in the steady-state[13]. Thus, the larger are σ and δ the more efficient will firms have to be in order to survive. Clearly, given the uniform distribution, there will be a monotonic relationship between the efficiency of the marginal firms and the average industry efficiency. Thus, as price competition becomes tougher and the industry efficiency cut-off point falls, the average industry efficiency increases.

Although we have underlined that both of these parameters contribute to the determination of the extent of price competition in the market, it is worth bearing in mind that they play separate roles. Even though the steady state efficiency (β^{**}) is negatively related to both, their effects on other variables characterizing the steady-state market structure will not always be of the same nature. A first evidence of this emerges if we examine how comparative static changes of these parameters affect the variety of **types of technology** characterizing the steady-state of the industry. Denoting the number of types of technology in steady-state by $Z^{**}=\beta^{**}-1+\delta$, it is clear that - for any given value of δ - as σ increases Z^{**} becomes smaller,

[13] Within a duopoly by Wathieu (1993) finds a negative relationship between inter-firm cost gaps and industry efficiency and argues that productivity gaps weaken competition. However, it is worth noticing that Wathieu's model does not allow for the endogenous determination of the industry steady-state efficiency. These points are discussed in Montagna (1995b).

given that $(d\beta^{**}/d\sigma)<0$. As a result, as price competition becomes tougher because of larger values of σ, the heterogeneity of technology characterizing the steady-state reduces. The effect of changes in the degree of technical heterogeneity (δ), however, are more complex. In fact, for any given σ, as δ increases **both** β^{**} and $(1-\delta)$ become smaller, *i.e.* they both move leftwards on the marginal cost distribution. Hence, the net effect on the width of the distribution of an increase in δ will depend on the relative size of the changes in its two limiting values. The variable Z^{**} has been numerically evaluated over the usual parameters intervals. The findings do not suggest a monotonic behaviour. As is illustrated in Figure 3.5, variability of firm's technologies increases up to certain values of δ after which subsequent increases of the degree of technical heterogeneity will reduce the steady-state technical variability. The value of δ at which $\frac{dZ^{**}}{d\delta}$ becomes negative are smaller the larger is the value of σ at which the analysis is carried out. Clearly, $\frac{dZ^{**}}{d\delta}>0$ if $\left|\frac{d(1-\delta)}{d\delta}\right|>\left|\frac{d\beta^{**}}{d\delta}\right|$. For Z^{**} to be negatively related to δ, the fall in the magnitude of the efficiency cut-off point must dominate the change in the inferior limit of the distribution. This will be more likely to happen the tougher is price competition, *i.e.* the larger is σ given that while β^{**} falls with σ, $(1-\delta)$ is not affected by it.

These conclusions are supported by the variance (V) of marginal cost in steady-state

$$V(\beta_i) = \int_{1-\delta}^{\beta^{**}} \left(\beta_i - E[\beta_i]\right)^2 g(\beta)\, d\beta$$

$$= \frac{\beta^{**3} - (1-\delta)^3}{3(\beta^{**}-1+\delta)} - \left(\frac{\beta^{**2} - (1-\delta)^2}{2(\beta^{**}-1+\delta)}\right)^2 \qquad (3.31)$$

whose behaviour with respect to σ and δ reflects that of Z^{**} (see Figure 3.6). Thus, if price competition - as determined by σ - is sufficiently tough, the larger is δ the smaller will be the steady-state degree of firms' technical heterogeneity. Therefore, for sufficiently tough price competition the steady-state degree of homogeneity of the surviving firms in terms of technical efficiency is directly related to the pre-steady-state degree of heterogeneity, defined by the magnitude of the parameter δ. If σ is sufficiently large, the greater is the difference amongst firms the closer will be the steady-state degree of uniformity in technology to the symmetric equilibrium of the standard uniform cost model.

As long as there is a degree of heterogeneity amongst surviving firms, the steady-state will be characterized by a **spectrum** of profit rates along with a structure of quantities and market shares. Given that the variability of technical efficiencies varies with σ and δ, it is interesting at this point to analyze how comparative static changes of these parameters affect the steady-state variability of prices, quantities and market shares.

The variance of prices will be given by $V(P_i)= \int_{1-\delta}^{\beta^{**}} \left(P_i-E[P_i]\right)^2 g(\beta)d\beta$. This yields

$$V(P_i) = \left[\frac{\beta^{**3} - (1-\delta)^3}{3(\beta^{**}-1+\delta)} - \left(\frac{\beta^{**2} - (1-\delta)^2}{2(\beta^{**}-1+\delta)} \right)^2 \right] \left(\frac{\sigma}{\sigma-1} \right)^2 \qquad (3.32)$$

from which it is evident that $V(P_i) = \left(\frac{\sigma}{\sigma-1}\right)^2 V(\beta_i)$. Obviously, for any value of σ, $V(P_i)$ is a monotonic transformation of $V(\beta_i)$, hence its behaviour with respect to δ is identical to that of $V(\beta_i)$. Numerical evaluation of *(3.32)* shows that the behaviour of steady-state price variability with respect to σ also reflects that of $V(\beta_i)$, with prices becoming more homogeneous as, for any given degree of technical heterogeneity, σ falls.

The variance of quantities produced will be given by

$$V(D_i) = \int_{1-\delta}^{\beta^{**}} \left(D_i - E[D_i] \right)^2 g(\beta)\, d\beta$$

$$= \left[\frac{\beta^{**1-2\sigma} - (1-\delta)^{1-2\sigma}}{(1-2\sigma)(\beta^{**}-1+\delta)} - \left(\frac{\beta^{**1-\sigma} - (1-\delta)^{1-\sigma}}{(1-\sigma)(\beta^{**}-1+\delta)} \right)^2 \right] \left(\frac{A}{N^{**}} \right)^2 \left(\frac{\sigma}{\sigma-1} \right)^{-2\sigma} P^{2(\sigma-\eta)} \qquad (3.33)$$

As is illustrated in Figure 3.7, for given values of δ, the variability of firms output increases in σ. Recalling that $V(P_i)$ falls with σ, this outcome reflects the fact that as price becomes more important in determining consumer's choice (because varieties become closer substitutes for one another), **smaller** differences in price between varieties generates **larger** differences in the quantities produced and sold. For given values of the elasticity of substitution between varieties, the variability of steady-state output levels is positively related to δ.

Finally, we examine the variability of steady-state market shares in terms of value. From equation *(3.8)*, the expected market share in terms of value[14] of a surviving firm is given by

$$E(S_i) = \int_{1-\delta}^{\beta^{**}} \frac{P_i D_i}{P^{**} D} \, g(\beta) \, d\beta$$

$$= \left(\frac{\sigma}{(\sigma-1)}\right)^{1-\sigma} \left(\frac{\beta^{**2-\sigma} - (1-\delta)^{2-\sigma}}{(2-\sigma)(\beta^{**}-1+\delta)}\right) \frac{1}{N^{**}} P^{**\sigma-1} \qquad (3.34)$$

which, given P^{**} from equation *(3.23)*, implies

$$E(S_i) = \frac{1}{N^{**}} \qquad (3.35)$$

The variance of steady-state market shares is given by

$$V(S_i) = \int_{1-\delta}^{\beta^{**}} \left(S_i - E[S_i]\right)^2 g(\beta) \, d\beta \qquad (3.36)$$

which on substitution yields

$$V(S_i) = \left(\frac{1}{N^{**}}\right)^2 \left(\frac{(2-\sigma)^2 \, (\beta^{**}-1+\delta) \left(\beta^{**3-2\sigma} - (1-\delta)^{3-2\sigma}\right)}{\left(\beta^{**2-\sigma} - (1-\delta)^{2-\sigma}\right)^2 \left(3-2\sigma\right)} - 1\right) \qquad (3.37)$$

Our numerical evaluations of $V(S_i)$ indicate that market share variability in steady-state is affected by comparative static changes in δ and/or σ in the same way as output variability (see Figure 3.8).

---

[14] We adopt a value definition of market share because of the heterogeneous nature of the product.

That is, $V(S_i)$ is a monotonically increasing function of both σ and δ. As before, these results reflect the fact that as price competition becomes fiercer small differences in price between varieties generate large differences in market shares. Hence, the industry will be characterized by a higher degree of concentration of demand on the relatively cheaper varieties.

3.6. ANALYSIS OF MARKET STRUCTURE

The previous section showed that comparative static increases in the toughness of price competition lead to a higher average efficiency reflected by lower values of β^{**}. This, in turn, will correspond to lower values of the steady-state industry price index (P^{**}), as is clear from equation *(3.23)*. Furthermore,

> **Proposition 3.3:** An increase in the **toughness** of price competition, and in the industry average efficiency, leads to **i)** an increase in market concentration and **ii)** an increase in the industry average profitability.

The two points of the proposition will be discussed below in turn.

3.6.1. Market concentration

It is generally agreed that the two relevant aspects of industry structure which should be captured by a measure of concentration are the number of firms and their size inequality. Clearly, other things equal, the number of firms is inversely related to concentration. However, when firms differ in size, the number of firms in an industry becomes an ambiguous measure of concentration and the other factor, size variability, has to be taken into account. Normally, concentration will be directly related to variability. A few problems have emerged in the literature which relate to **(i)** the measurement of variability, **(ii)** the measurement of size, and **(iii)** the way of combining size variability with firm numbers. The literature has not provided any unique answer to these issues. Amongst the units to measure size, market share is the most popular. If the product is homogeneous, market shares will be expressed in real terms, *i.e.* $s_i = Q_i/Q$ (where $Q = \sum_{i=1}^{N} Q_i$). If products are differentiated, as in our case, market shares will be expressed in terms of value, as in equation *(3.8)*. Obviously, if all costs were the same, $S_i=S_j$ for all $i \neq j$ and $S_i=(1/N^{**})$ for all i. Hence, there will be an inverse relationship between market share and number of firms. If costs differ, however, there will be some variability in market shares. This is clearly the case in the present context characterized by a distribution of marginal costs, where, as shown by equation *(3.16)*, the market share held by one firm depends on the relative size of the firm's marginal cost.

Although there is no consensus as to the best way of combining size variability and firm numbers[15] given that, as stressed by Jaquemin (1987), all indexes involve some *"value judgment"*, general agreement exists on the properties that a concentration index should have. If $\mathcal{C}=\mathcal{C}(S_1,\ldots,S_N)$ is a concentration index then, if the function $\mathcal{C}$ is symmetric and strictly convex, certain desirable

---

[15] We shall not enter here the details of this debate, because it would be beyond the aims of this work. Instead we refer, amongst others, to Encaoua and Jaquemin (1980), Schmalensee (1982) and Jaquemin (1987).

properties will be satisfied. In particular, for any given number of firms, *"the measure of concentration takes its minimum value when the firms have equal shares"* and if firms are identical *"the measure of concentration must not increase with an increase in the number of firms"* (Encaoua and Jaquemin 1980).

An index of concentration which satisfies these properties is the Herfindhal's index *(H)* that is

$$H = \sum_{i=1}^{N} S_i^2 \tag{3.38}$$

In frameworks, as in the present one, in which firms differ only in their marginal cost and act non-cooperatively, the Herfindhal's index is considered to be a sensible concentration measure (see Schmalensee, 1982). Note that in the index, market shares are weighed according to a weight function which gives more importance to the biggest firms[16]. The range of variation of the index is $[1/N,\ 1]$. Its lower value, $1/N$, results when firms are homogeneous with respect to their market shares. Following Jaquemin (1986), we can write the Herfindhal's index of concentration as

$$H = N\ V(S_i) + \frac{1}{N} \tag{3.39}$$

so as to distinguish the two factors that the index ought to reflect, namely number of firms and size variability. Clearly, the latter is measured by the variance of market shares. In this work we shall adopt this measure of concentration.

---

16 The opposite happens, for instance, with the entropy index which reduces the importance of the biggest firms. See Jaquemin (1987) for a discussion of alternative measures.

As the average efficiency in the industry increases, a smaller number of firms will survive in steady-state. In fact, N^{**} is decreasing in both δ and σ (N^{**} is plotted in Figure 3.9). As a result, the ratio $1/N^{**}$ increases as industry efficiency increases which suggests the occurrence of an increase in concentration. Also, recall that $E(S_1)=1/N^{**}$. Hence, as the average industry efficiency increases, a smaller number of firms holding (**on average**) larger market shares survive in the industry.

From equation *(3.37)* we know that as market efficiency increases - and as the number of firms falls - market share variability increases. Hence, as price competition becomes tougher, the number of firms surviving in the industry falls, the steady-state expected market share of a firm increases, and the gaps in market shares widens. Clearly, comparative static changes in σ and/or δ affect firms' number and size inequality in a consistent fashion indicating that a tougher price competition leads to a higher industry's average efficiency and to a higher concentration. This can be verified by substituting equation *(3.37)* into equation *(3.39)* to obtain the Herfindhal's index, that is

$$H^{**} = \frac{1}{N^{**}} \frac{(2-\sigma)^2 \, (\beta^{**}-1+\delta) \left(\beta^{**3-2\sigma} - (1-\delta)^{3-2\sigma}\right)}{\left(\beta^{**2-\sigma} - (1-\delta)^{2-\sigma}\right)^2 \left(3-2\sigma\right)} \tag{3.40}$$

The index has been evaluated within the usual parameters intervals[17]. The results, illustrated in Figure 3.10, confirm that as price competition becomes tougher industry concentration increases.

[17] Note that H is not defined for $\sigma=1.5$.

3.6.2. Profitability

As stated by the proposition, the higher is the average industry efficiency the higher is the expected profit of a surviving firm. From equation *(3.27)*, it is obvious that the extent of equilibrium surplus profits is dependent on the state of technology δ, the elasticity of substitution between varieties σ, and the fixed production cost K. Other things being equal, the higher is the fixed production cost, the higher will have to be the average efficiency of firms which manage to survive and thus the larger will be the average profit margin of the industry in steady-state. As was shown in Figure 3.3, an increase in the degree of heterogeneity amongst firms would generate an increase in the steady-state level of supernormal profits. The graph shows clearly that expected supernormal profits diminish as δ becomes very small. In the limit, if $\delta=0$, *i.e.* if firms were identical, entry would eliminate positive profit. This is in line with the traditional version of the monopolistic competition model which turns out to be a special case of the model developed here. Finally, for a given δ, the steady-state expected profit will be larger the larger is σ. Similarly, the expected profit margin[18], defined as

$$M^{**} = \int_{1-\delta}^{\beta^{**}} \frac{\Pi_i(\beta, N^{**})}{P_i D_i} \, g(\beta) \, d\beta \qquad (3.41)$$

is also monotonically increasing in δ, as can be seen from Figure 3.11.

---

[18] Note the difference between the **expected** profit margin in equation *(3.41)* below and the steady-state profit margin of any firm i given by equation *(3.28)*.

The dispersion of profits at the industry level is also related to the toughness of price competition. The variance of the steady-state profits is given by

$$V(\Pi_i) = \int_{1-\delta}^{\beta^{**}} \left(\Pi_i - E[\Pi_i]\right)^2 g(\beta)\, d\beta \tag{3.42}$$

which has been numerically evaluated for the usual parameter intervals. The results, plotted in Figure 3.12, show that profit inequality increases as price competition becomes tougher.

Thus, competition between firms with different costs leads to a steady-state level of efficiency which is higher the tougher is competition. A direct relationship emerges between efficiency, industry concentration and profitability[19].

3.6.3. Market size, aggregate demand and concentration

This section will briefly analyze the impact on market structure of the exogenous factors affecting aggregate demand, namely the price elasticity η and the measure of nominal income A.

First, note that the efficiency cut-off point β^{**} is invariant with respect to η. From equation *(3.40)* it is then evident that the impact of comparative static changes of η on market concentration can be fully analyzed by focusing on the behaviour of the steady-state number of firms. From equation *(3.21)*, we get

$$\frac{dN^{**}}{d\eta} = (-lnP^{**})N^{**} \tag{3.43}$$

[19] A survey of the empirical evidence on the relationship between concentration and profitability and concentration and market size can be found in Schmalensee (1989).

Clearly, $\frac{dN^{**}}{d\eta}>0$ if $P^{**}<1$, $\frac{dN^{**}}{d\eta}=0$ if $P^{**}=1$ and $\frac{dN^{**}}{d\eta}<0$ if $P^{**}>1$. Intuitively, the relationship between the steady-state number of firms and the price elasticity of demand can be appreciated by considering the relationship between the demand for the differentiated good as whole *(D)* and η. From equation *(3.5)*, we get $\frac{dD}{d\eta}=(-lnP^{**})D$; hence, $\frac{dD}{d\eta}\begin{cases}<\\=0\\>\end{cases}$ if $P^{**}\begin{cases}>\\=1.\\<\end{cases}$

It follows that if $P^{**}<1$, an increase in η will increase aggregate demand and this will lead, in turn, to an increase in the number of firms the market can sustain. Clearly, for a given price index, as D increases the market can sustain more varieties. If, instead, $P^{**}>1$, a *ceteris paribus* increase in the price elasticity of demand η will reduce aggregate demand and the number of firms in the industry will fall. Given that β^{**} (and consequently P^{**}) is independent of η, a change in η, leading to a change in D, will basically correspond to a **change in the extent of the market**: concentration will increase (fall) if $\Delta\eta$ leads to a fall (increase) in D, with the sign of ΔD depending on whether P^{**} is greater or smaller than one. This, in turn, will depend on the size of σ and δ. The smaller are these parameters, the lower is the steady-state efficiency, and the higher will the price index be. Indeed, our numerical evaluations suggest that for sufficiently small values of the parameters which determine the toughness of price competition, $P^{**}>1$. Therefore, the relationship between the steady-state number of firms and the price elasticity η is not monotonic.

Finally, note that a *ceteris paribus* increase in A will generate an increase in market size. If we define the latter by total sales, *i.e.* $P^{**}D = AP^{**1-\eta}$ it is obvious that as A increases market size increases[20]. This, in turn, would increase the number of firms sustained by the market, as can be seen from equation *(3.21)*. Hence, as market size increases, concentration *ceteris paribus* falls.

3.7. THE EVOLUTION OF INDUSTRY

As discussed in sub-section 3.4.3., a complex entry and exit dynamics takes place as the industry moves to its steady-state situation. We now try to assess more precisely the nature of this evolution by defining an hypothetical **"original state"** of the industry and compare it to the steady-state. To this end, we modify the exogenous market structure model of Section 3.3 to incorporate the following assumptions. 1) Incumbents' efficiencies are uniformly distributed over the whole interval $[1-\delta,\ 1+\delta]$; and 2) marginal firms are those whose marginal cost is given by $(1+\delta)$. In other words, at the beginning of the industry's history the efficiency cut-off point corresponds to the upper limit of the distribution describing the state of technology, *i.e.* $\beta^{*}=(1+\delta)$. The zero profit condition defining the marginal firms will be

$$\Pi(1+\delta) = \frac{\varphi A}{N^{b}} P^{b(\sigma-\eta)}(1+\delta)^{1-\sigma} - K = 0 \tag{3.44}$$

where the superscript b is used to refer to the variables which characterize the beginning of the industry. Solving equation *(3.44)* for N^{b} yields

$$N^{b} = \frac{\varphi A}{K} P^{b(\sigma-\eta)}(1+\delta)^{1-\sigma} \tag{3.45}$$

---

20 Note that $\eta=1$ implies $P^{**}D=AP^{**1-\eta}=A$.

where the price index will be

$$P^{b} = \left(\frac{1}{N^{b}}\right)^{\frac{1}{1-\sigma}} \frac{\sigma}{(\sigma-1)} \left(\frac{N^{b}}{2\delta} \int_{1-\delta}^{1+\delta} \beta_{i}^{1-\sigma} d\beta\right)^{\frac{1}{1-\sigma}}$$

$$= \frac{\sigma}{(\sigma-1)} \left(\frac{(1+\delta)^{2-\sigma}-(1-\delta)^{2-\sigma}}{(2-\sigma)\ 2\delta}\right)^{\frac{1}{1-\sigma}} \tag{3.46}$$

A potential entrant would find this situation attractive and would attempt to enter the industry. In order to see this, let us consider the expected profit of entry when the industry structure is described by the above equations, that is

$$V^{E}(N^{b}) = \int_{1-\delta}^{1+\delta} \left(\frac{\varphi A}{N^{b}} P^{b(\sigma-\eta)} \beta_{i}^{1-\sigma} - K\right) \frac{1}{2\delta} d\beta \tag{3.47}$$

which, given equations *(3.45)* and *(3.46)* yields

$$V^{E}(N^{b}) = K \left(\frac{(1+\delta)^{2-\sigma} - (1+\delta)^{2-\sigma}}{2\delta\ (2-\sigma)} (1+\delta)^{\sigma-1} - 1\right) \tag{3.48}$$

which will be positive if $\left(\frac{(1+\delta)^{2-\sigma} - (1+\delta)^{2-\sigma}}{2\delta\ (2-\sigma)} (1+\delta)^{\sigma-1}\right) > 1$. It can be shown that this condition always holds for all values of σ and δ within the intervals of interest. Hence, if $\beta^{**}=1+\delta$ the expected profit of entry is positive and there will be an incentive for firms to enter the industry. Furthermore, note that the expected value of entry is positively related to both σ and δ, hence the tougher is price competition the stronger will be the incentive to enter the industry when it is at its initial market structure.

As a result, the entry and exit process discussed in this chapter will set in. *Ceteris paribus*, entry will reduce incumbents' revenue and the marginal firms will be forced to exit with the efficiency cut-off point moving leftwards on the distribution. The resulting reduction in the industry price index will increase demand and - trough it - the expected profit of potential entrants. New entry will take place with more efficient entrants displacing less efficient (marginal) incumbents. Consistently with this analysis, by comparing equation *(3.46)* to equation *(3.23)* it is clear that $P^b > P^{**}$ always holds (see Figure 3.13). Furthermore, from Figure 3.14, where we have plotted the ratio (N^{**}/N^b) against δ for several values of σ, one can see that $N^b < N^{**}$, with the difference between the two increasing in both σ and δ. Hence, as the industry evolves towards its steady-state market structure the number of firms increases and the price index falls. Relative to its original situation, the industry steady-state will be characterized by a lower dispersion of efficiencies, prices and market shares. These points can be proved by comparing $V(\beta_i)$, $V(P_i)$, $V(S_i)$ from equations *(3.31)* *(3.32)* and *(3.37)* to their corresponding values at the beginning of the industry, respectively given by

$$V(\beta_i) = \frac{\delta^2}{3} \qquad (3.49)$$

$$V(P_i) = \left(\frac{\sigma}{\sigma - 1}\right)^2 V(\beta_i) \qquad (3.50)$$

and

$$V(S_i^b) = \int_{1-\delta}^{1+\delta} \left(S^b - E[S_i^b]\right)^2 \frac{1}{2\delta}\, d\beta$$

$$= \left(\frac{1}{N^b}\right)^2 \left[\frac{(2-\sigma)^2\, 2\delta \left[(1+\delta)^{3-2\sigma} - (1-\delta)^{3-2\sigma}\right]}{\left[(1+\delta)^{2-\sigma} - (1-\delta)^{2-\sigma}\right]^2 \left(3-2\sigma\right)} - 1\right] \qquad (3.51)$$

Our numerical evaluations - illustrated in Figures 3.15, 3.16, and 3.17 - suggest that variability of marginal cost, prices and market shares is lower in the steady-state than at the beginning of the industry. This, together with the fact that the number of firms will increase, is reflected by a lower steady-state degree of concentration. Using equation *(3.51)* to determine the Herfindhal's index, we get

$$H^b = \frac{1}{N^b} \frac{(2-\sigma)^2\, 2\delta \left[(1+\delta)^{3-2\sigma} - (1-\delta)^{3-2\sigma}\right]}{\left[(1+\delta)^{2-\sigma} - (1-\delta)^{2-\sigma}\right]^2 \left(3-2\sigma\right)} \qquad (3.52)$$

As shown in Figure 3.18 where the ratio $\frac{H^{**}}{H^b}$ is plotted, concentration is higher in the original situation of the industry.

The above analysis suggests that there will be a **net** increase in the industry number of firms as a result of the entry and exit process; in other words, the entry flow will be larger than that represented by the displaced less efficient firms which will be forced to exit.

Finally, given equation *(3.45)* the expected profit of a firm at the beginning of the industry's history *(R^b)* will be given by

$$R^{b} = \int_{1-\delta}^{1+\delta} \left(\frac{\varphi A}{N^{b}} P^{b(\sigma-\eta)} \beta^{1-\sigma} - K \right) \frac{1}{2\delta} d\beta$$

$$= K \left[\frac{(1+\delta)^{2-\sigma} - (1-\delta)^{2-\sigma}}{2\delta(2-\sigma)} (1+\delta)^{\sigma-1} - 1 \right] \tag{3.53}$$

Comparing equation *(3.53)* with equation *(3.27)* shows $R^{**} < R^{b}$ to hold for all values of the relevant parameters (see Figure 3.19).

Therefore, the evolution of the industry seems to be consistent with what is generally supported by the literature, with entry reducing (but not eliminating) profits and the steady-state being characterized by a larger number of firms.

3.8. HETEROGENEOUS VERSUS HOMOGENEOUS EQUILIBRIUM

The aim of this section is to further highlight the implications of the assumption of heterogeneous technology by comparing the model developed so far to one characterized by homogeneous costs. For clarity of exposition the subscripts *s* (symmetric) and *a* (asymmetric) will henceforth be used to refer to the homogeneous and heterogeneous firms industries respectively.

The industry with homogeneous firms is assumed to be identical to the one analyzed in the previous sections in every respect but in the hypothesis concerning the marginal cost β, which is the same for all firms, *i.e.* $\beta_{si}=\beta_{s}$ for all *i*. Thus, firms in the two industries will face the same demand structure, the same type of technology and the same fixed cost K (for which no industry subscript will be used). It follows that even in the homogeneous case each firm will specialize in the production of one single variety of the differentiated good.

Hence, the demand function facing a firm i in the symmetric industry will be identical to the demand function in *(3.6)*, *i.e.* $D_{si}=\frac{A}{N_s}P_s^{\sigma-\eta}P_{si}^{-\sigma}$. The profit function of a firm i, for $D_{si}=Q_{si}$, however will be

$$\Pi_{si} = P_{si}D_{si} - \beta_s D_{si} - K \tag{3.54}$$

where, because of the hypothesis of identical costs amongst firms, no subscript i is attached to the marginal cost β_s. Assuming, as before, that the choice variable of the firm is price, the first order condition for profit maximization will yield the optimal price rule $P_{si}=\sigma(\sigma-1)^{-1}\beta_s$. Obviously, the absence of cost differences amongst firms, together with the absence of asymmetries in demand, is such that $P_{si}=P_{sj}$ for all $j\neq i$. Moreover, given the definition of price index in equation *(3.3)* the following will hold

$$P_{si} = P_s = \frac{\sigma}{\sigma-1}\beta_s \tag{3.55}$$

Hence, given *(3.55)*, the demand function can be written as

$$D_{si} = \frac{A}{N_s}P_s^{-\eta} \tag{3.56}$$

which implies that all firms face the same equilibrium demand and will sell the same quantities. Substituting *(3.56)* into *(3.54)* yields the equilibrium profit, that is

$$\Pi_{si} = \frac{A}{N_s}\beta_s^{1-\eta}(\sigma-1)^{\eta-1}\sigma^{-\eta} - K \tag{3.57}$$

Clearly, no inter-firm differences in profits will exist. Finally, entry into the industry will continue until the elimination of supernormal profit occurs. The zero-profit condition can then be imposed on equation *(3.57)* to determine the steady-state number of firms for any given β_s, that is

$$N_s^{**} = \frac{A}{K} \beta_s^{1-\eta} (\sigma-1)^{\eta-1} \sigma^{-\eta} \qquad (3.58)$$

Proposition 3.4: As in the heterogeneous firms case, the tougher is price competition the higher is the steady-state concentration (*i.e.* the smaller is the number of firms in the industry).

Note that in this case price competition is only determined by σ. By differentiating N_s^{**} with respect to σ we get

$$\frac{dN_s^{**}}{d\sigma} = N_s^{**} \left(\frac{\eta-1}{\sigma-1} - \frac{\eta}{\sigma} \right) \qquad (3.59)$$

which suggests that for any given value of the marginal cost β_s, $\frac{dN_s^{**}}{d\sigma} > 0$ **if and only if** $\eta > \sigma$ which we have ruled by plausibility assumption. It follows that for all $\sigma > \eta$, $\frac{dN_s^{**}}{d\sigma} < 0$. The elasticity of substitution between varieties *(σ)* determines, other things equal, the intensity of the competitive pressure on price. If, *ceteris paribus*, σ increases, and varieties become better substitutes for one another, the equilibrium price falls (and with it a firm's market power) and the number of brands in the free-entry equilibrium becomes smaller, given that the incentive to enter is lower. However, the relationship between concentration and efficiency is not the same as in the heterogeneous case.

Proposition 3.5: When firms produce the differentiated varieties with identical costs, an increase in market efficiency may or may not increase market concentration.

As we saw, in the heterogeneous case industry there exists a positive relationship between steady-state efficiency and concentration. When firms have homogeneous technologies, given the absence of any other source of asymmetry, concentration will be determined solely by the number of firms. By differentiating N_s^{**} with respect to β we obtain

$$\frac{dN_s^{**}}{d\beta_s} = \frac{A}{K} (\sigma-1)^{\eta-1} \sigma^{-\eta} (1-\eta) \beta_s^{-\eta} \tag{3.60}$$

First, note that for $\eta=1$, $\frac{dN_s^{**}}{d\beta_s}=0$. This case is of particular interest because it corresponds to the typical Dixit-Stiglitz model specification. The latter is based on a Cobb-Douglas utility function which generates a first-stage solution to the consumer's maximization problem that consists of a demand function for the differentiated good as a whole which is unit elastic with respect to price. Clearly, from equation *(2.19)*, $(dlnD/dlnP)=-1$, and for $\eta=1$, equation *(3.58)* becomes

$$N_s^{**} = \frac{A}{K} \sigma^{-1} \tag{3.61}$$

which indicates the absence of a link between market efficiency (as measured by the marginal cost) and concentration. Instead, the zero-profit equilibrium number of firms only depends on the total expenditure on the good (note that for $\eta=1$, $A=PD$) relative to the per-firm fixed cost and on the elasticity of substitution between varieties.

More generally, for $\eta \neq 1$, a relationship between concentration and efficiency will exist, but will not always be consistent with that stemming from the heterogeneous firms model. From equation *(3.60)* is clear that $\frac{dN_s^{**}}{d\beta_s}$ is positive for $\eta<1$ and negative for $\eta>1$. In other words, an increase in market efficiency (*i.e.* a fall in β_s) **i)** increases concentration if the demand for the differentiated good as a whole is inelastic and **ii)** reduces concentration if the demand for the differentiated good as a whole is elastic. Thus, the relationship between efficiency and concentration identified for the heterogeneous firms case only holds here for $\eta<1$. If $\eta>1$, higher efficiency leads to a larger number of firms operating in the industry.

The negative relationship between efficiency and concentration found for $\eta>1$ is not consistent with the empirical regularity which often emerges between efficiency (and profits) and concentration[21] Therefore this result for $\eta>1$ may represent another of the (predictive) costs involved in adopting the simplifying assumption of identical firms. This is particularly relevant considering that this relationship occurs in circumstances (*i.e.* $\eta>1$) which are likely to be associated with a differentiated product. Whilst this issue remains one for a case-by-case empirical assessment, it can intuitively be argued that product differentiation is a phenomenon more likely to characterize markets for goods whose demand is price elastic rather than necessary goods with low price elasticity of

---

21 See Schmalensee (1989).

demand.

The origin of the difference of the steady-state efficiency/concentration relationship, in the heterogeneous and homogeneous firms cases, stems from the fact that whilst in the former efficiency is linked to the parameters which determine the fierceness of price competition, in the latter it is exogenously given. As was previously stressed, the acknowledgment of the existence of technical differences amongst firms allows to **endogenize** the **efficiency** of the surviving firms in steady-state by directly relating it to the parameters which determine the toughness of price competition. Hence, efficiency is an endogenous product of competition between firms. As a result, not only does the toughness of price competition affect market structure directly, but also indirectly *via* the efficiency of those firms which manage to survive. In the homogeneous model there is no endogenous link between efficiency and the toughness of price competition and no endogenous determination of the marginal firms' efficiency.

This analysis strengthens the importance of the hypothesis of technical heterogeneity amongst firms whose relevance is clearly not merely due to its realism. The fact that in the real world firms are different makes this hypothesis valuable *per se*. However, its full relevance lies in its implications for market structure analysis, by allowing to endogenize the link between efficiency, toughness of price competition and concentration.

As a minor point, note that the relationship between N_s^{**} and the price elasticity of the demand for the good as a whole (η) is analogous to that found in the heterogeneous case. From equation

(3.58) we have

$$\frac{dN_s^{**}}{d\eta} = N_s^{**}\, ln\left(\frac{\sigma-1}{\beta\sigma}\right) \tag{3.62}$$

Clearly, $\frac{dN_s^{**}}{d\eta}>0$ if $\frac{\sigma-1}{\beta_s\sigma}>1$ which will hold for $\sigma>\frac{1}{1-\beta_s}$. Let us assume - for simplicity as well as for comparability purposes - that β_s is, as β_a^{**}, smaller than unity. In this case, from equation *(3.55)*, when $\sigma>\frac{1}{1-\beta_s}$, $P_s<1$. But, as we saw from equation *(3.5)*, if $P_s<1$, $(dD/d\eta)>0$. Consistently with what we found in the heterogeneous costs case, if a change in η leads to an increase in aggregate demand, it will generate an increase in the number of firms sustained by the market[22]. Obviously, there is no reason why P_s should be smaller than one. For sufficiently large values of β_s and for sufficiently small values of σ, P_s may turn out to be greater than unity. As in the heterogeneous cost industry, in this event an increase in η will lead to a fall in D and in the number of firms the market can sustain. For any given β_s, the larger is σ and the better substitutes are varieties for one another, the lower will be P_s and the more likely will D and N_s^{**} increase as η rises.

3.9. HETEROGENEOUS VERSUS HOMOGENEOUS FIRMS: SOME WELFARE CONSIDERATIONS

This section extends the comparison between the homogeneous and heterogeneous costs models. Without aiming at an exhaustive analysis,

---

22 Note that, even in the homogeneous cost industry, industry price (which here corresponds to the firm price) and the marginal cost (here exogenously given) are unaffected by η.

some of the differences between the welfare implications of the two models will be highlighted. Clearly, given the different steady-state efficiencies and market structures of the two models, their welfare implications will also be different.

3.9.1. Consumer welfare

We shall start by comparing the levels of welfare consumers achieve in the two hypothetical situations. In this setting, assuming that all other things remain equal, two factors affect consumers' welfare, namely the industry price index and the number of varieties.

Assuming that the two industries are characterized by the same price elasticities σ and η, let us begin by examining $\beta_s=\beta_a^{**}$ as a benchmark case. The determination of the relationship between the two industries' price levels is straightforward. Notice that if the homogeneous firms industry's marginal cost equals the heterogeneous firms industry's efficiency cut-off point, the **average** industry efficiency will be higher in the latter (where all but the marginal firms have $\beta_{ai}<\beta_s=\beta_a^{**}$) than in the former. Hence, for all values of δ and σ, $P_a^{**}<P_s$. As far as the relative number of firms is concerned, using equation *(3.24)* in *(3.58)*, we obtain the ratio

$$\frac{N_a^{**}}{N_s^{**}} = (\sigma-1)^{\sigma-\eta}\sigma^{\eta-\sigma}P_a^{**\sigma-\eta}(\beta_a^{**})^{\eta-\sigma} \tag{3.63}$$

which can be shown to be smaller than unity for all values of the relevant parameters within the intervals under consideration. The number of firms in the homogeneous firms industry is always larger than in the heterogeneous one. Hence, when the homogeneous industry is on average less efficient than the heterogeneous one it provides the market with a larger number of varieties. Price competition is tougher in the heterogeneous industry because the average industry efficiency is higher than in the homogeneous one. As a result, given the (monotonic) positive relationship between efficiency and concentration in the former, the market shows a smaller number of firms than in the other industry.

Hence, whilst consumers are better off in the homogeneous firms industry as far as the number of varieties is concerned, the price element favours consumers in the heterogeneous industry, where it is lower due to the existence of firms with different efficiencies. We can now turn to determine the **net welfare** position of the two sets of consumers by looking at their indirect utility function. This will be given by

$$W_j = A\, N_j^{**1/(\sigma-1)}\, P_j^{-\eta} \tag{3.64}$$

where *j=a,s*. The indirect utility functions in *(3.64)* are obtained by substituting the optimal price for each variety i into the utility function in equation *(3.1)* and writing it in terms of P_j *(j=a,s)*, where P_a^{**} and P_s are given by equations *(3.23)* and *(3.55)* respectively. From *(3.64)* we obtain the ratio

$$\frac{W_a}{W_s} = \left(\frac{P_a^{**}}{P_s}\right)^{-\eta} \left(\frac{N_a^{**}}{N_s^{**}}\right)^{1/(\sigma-1)} \tag{3.65}$$

which, given *(3.63)* becomes

$$\frac{W_a}{W_s} = \left(\frac{P_a^{**}}{P_s}\right)^{-\eta} \left((\sigma-1)^{\sigma-\eta}\sigma^{\eta-\sigma}P_a^{**\sigma-\eta}(\beta_a^{**})^{\eta-\sigma}\right)^{1/(\sigma-1)} \tag{3.66}$$

Considering that P_a^{**}, P_s and β_a^{**} are independent of η, by differentiating *(3.66)* with respect to η we get

$$d\left(\frac{W_a}{W_s}\right)/d\eta = \frac{W_a}{W_s}\left[ln\left(\frac{P_s}{P_a^{**}}\right) + (\sigma-1)^{-1}ln\left(\frac{\sigma\beta_a^{**}}{(\sigma-1)P_a^{**}}\right)\right] \tag{3.67}$$

Given that $P_s > P_a^{**}$, a sufficient condition of $d\left(\frac{W_a}{W_s}\right)/d\eta > 0$ is that $\frac{\sigma\beta_a^{**}}{(\sigma-1)P_a^{**}} > 1$ which can be written as $\frac{\sigma}{\sigma-1}\beta_a^{**} > P_a^{**}$. Note that the left-hand-side of this inequality is the price of the marginal firms, hence this condition is always satisfied, P_a^{**} being an average of prices of which those of the marginal firms are the highest. As a result, the ratio $\frac{W_a}{W_s}$ increases in η. Furthermore, it is clear from equation *(3.66)* that $\frac{W_a}{W_s} \begin{cases} >1 \\ =1 \\ <1 \end{cases}$ for $\eta \begin{cases} >1 \\ =1. \\ <1 \end{cases}$ Hence, if the demand for the differentiated product as a whole is price inelastic, the variety effect dominates the price effect, which means that consumers are better off in the homogeneous industry. Instead, if demand is price elastic, the price effect dominates the variety effect which means that consumers are better off in the more efficient heterogeneous industry.

For completeness, two other circumstances have been considered.

One in which all firms in the homogeneous industry are more efficient than in the heterogeneous one, *i.e.* $\beta_s<\beta_a^{**}$. The other where all firms in the former are less efficient than in the latter, that is $\beta_s>\beta_a^{**}$. As an example of these two situations we have looked at the two limiting cases where $\beta_s=1-\delta$ and $\beta_s=1+\delta$.

When $\beta_s=1-\delta$, the ratio in equation *(3.66)* becomes

$$\frac{W_a}{W_s} = \left[\frac{P_a^{**}}{P_s}\right]^{-\eta} \left[(\sigma-1)^{\sigma-\eta}\ \sigma^{\eta-\sigma}\ P_a^{**\sigma-\eta}\ \frac{\left(1+\delta\right)^{2-\sigma}-\left(1-\delta\right)^{2-\sigma}}{2\delta(2-\sigma)(1-\delta)^{1-\eta}}\right]^{1/(\sigma-1)} \tag{3.68}$$

and when $\beta_s=1+\delta$ the relative welfare measure will be

$$\frac{W_a}{W_s} = \left[\frac{P_a^{**}}{P_s}\right]^{-\eta} \left[(\sigma-1)^{\sigma-\eta}\ \sigma^{\eta-\sigma}\ P_a^{**\sigma-\eta}\ \frac{\left(1+\delta\right)^{2-\sigma}-\left(1-\delta\right)^{2-\sigma}}{2\delta(2-\sigma)(1+\delta)^{1-\eta}}\right]^{1/(\sigma-1)} \tag{3.69}$$

The results of the numerical evaluations we carried out will not be illustrated in any detail. We shall limit ourselves to report that - as one would expect - when the homogeneous industry is more efficient than the heterogeneous one the former yields a higher consumer welfare than the latter for all values of the relevant parameters intervals. The case described by equation *(3.69)* is not so clear-cut. The outcome can be shown to depend on the size of the price elasticities which determine which of the price and varieties effects on consumers' welfare prevails.

This section has highlighted that not only does the allowance for cost heterogeneity affect market structure, but also consumer welfare.

3.9.2. Total industry welfare

Whilst in a homogeneous firm context entry, *via* the imposition of the zero profit condition, leads to the elimination of long-run profits this does not happen, as our analysis shows, in the heterogeneous technology case whose steady-state is characterized by a spectrum of positive profit rates. Hence, any welfare comparison between the two industries needs to take the existence of such profits into account. In this section, we assess whether the persistence of profits generates changes in the welfare results obtained with reference to the consumer welfare analysis alone.

To this end, we proceed to the construction of the following total industry welfare function

$$W_j^{\Delta} = \alpha W_j + (1-\alpha) R_j^{**} \frac{N_j^{**}}{P_j} \qquad (3.70)$$

where the superscript Δ indicates **"social"** welfare[23], and R_j^{**} is the expected surplus profit in steady state; $0<\alpha<1$ is the weight given by - say - a social planner to the two welfare components[24]. The second term on the right-hand side of the equation represents the total expected profit of the steady-state industry $(R_j^{**} N_j^{**})$ **"deflated"** by the industry price index. Hence, it measures the value of the total

[23] Given the partial equilibrium nature of the analysis, in what follows social and industry welfare will be used interchangeably.

[24] We use the strong inequality in order to rule out the possibility of either producers or consumer welfare being of no value to the social planner.

industry profits in terms of the amount of the differentiated good which this profit can command[25].

Obviously, given the imposition of the zero profit condition, the expected profit in the homogeneous industry steady-state is zero. Hence, for the latter, total industry welfare will coincide to consumer welfare. Finally, note that as far as the heterogeneous industry is concerned, the total welfare measure above suffers from a limitation in that it does not take into account the welfare loss represented by the entry cost foregone by those firms whose entry attempt fails. This is due to the impossibility within this framework of determining the number of firms who do not manage to enter successfully. However, the consequences of this shortcoming are limited by the partial equilibrium nature of the analysis which allows one to focus only on the surviving industry. And, by virtue of the assumption that non-successful entrants will not re-attempt entry, the surviving industry does not bear the economic burden of the foregone sunk cost of failed attempts.

We have computed the ratio $\frac{W_a^{\Delta}}{W_s^{\Delta}} = \frac{W_a^{\Delta}}{W_s}$ for three different values of α *(=0.5, 0.3, 0.7)* so as to allow for different social planner preferences. For each of these three systems of social welfare weights, we have analyzed in turn the cases where $\beta_s=\beta_a^{**}$, $\beta_s=(1-\delta)$ and $\beta_s=(1+\delta)$. The results are quite intuitive and can thus be summarized.

---

[25] Note that this proxi for producer welfare can be added to the indirect utility function W_j in view of the fact that the utility function in *(3.1)* from which the latter is derived can be seen as a quantity index. From this it follows that the two welfare measures are expressed in the same unit of measurement.

1) For $\beta_s=\beta_a^{**}$, if profits weigh less than consumers' indirect utility in the total welfare function (*e.g.* $\alpha=0.7$), then no significant change in the outcome of the consumer welfare comparison is observable by taking profits into account. However, for $\alpha=0.5$ (and even more so for $\alpha=0.3$) the interval of the parameters within which firms heterogeneity makes consumers better off is larger than when profits are not taken into account. For instance, for $\delta=0.90$, $\frac{W_a}{W_s}>1$ for $\eta>1$ and for all values of $1.5\leq\sigma\leq5.3$, while for $4.5\leq\sigma\leq5.3$, $\frac{W_a^{\Delta}}{W_s}>1$ for $\eta\geq0.9$.

2) The case where $\beta_s=(1+\delta)$ is similar in nature to the previous one, with the interval of the parameters (η and σ) within which the heterogeneous industry increases welfare being larger once profits are taken into account.

3) For $\beta_s=(1-\delta)$, that is when the homogeneous industry is more efficient than the heterogeneous one, the inclusion of profits in the welfare function is not sufficient to yield $W_a^s>W_s$.

What our (preliminary) analysis suggests is that - as one would expect - the different welfare scenarios we have identified open *a* new direction for research, in particular towards the analysis (which is beyond the aim of this work) of a possible government role in trying to affect, for instance, the state of technology. Even though in the model there are no endogenous circumstances which may lead the industry from one state of technology to the other, it is possible to envisage a government policy aiming at reducing inter-firm differences in efficiency, by reducing the level of heterogeneity between firms (δ). This analysis suggests that the desirability of such policies - at least from the industry welfare point view - depends on the size of the relevant price elasticities, as well as on the marginal cost of the homogeneous industry relative to the heterogeneous industry's average efficiency.

3.10. A NOTE ON OPTIMUM PRODUCT DIVERSITY

As was mentioned in Chapter 2, one of the most frequently discussed issues in the product differentiation literature is whether there are two few or too many products in equilibrium with respect to the socially optimum number of varieties. In this section we highlight some of the implications of the previous analysis for this issue although we choose not to pursue an exhaustive treatment of this particular subject which lies beyond the aims of this work.

The main point we intend to make relates to the fact that the existence of cost heterogeneity in this model affects the problem of optimum product variety. In the standard uniform costs model as new products enter the industry, incumbents' profits fall and the question then arises as to whether entry stops before or after the maximum total surplus is achieved. As was mentioned in the previous chapter, there are two conflicting forces at work which affect the number of varieties. On the one hand, the existence of fixed costs implies that revenue may not be large enough to cover the cost of a socially desirable product. This is to say that products, at an optimum, may be produced at a loss. Hence, this force may imply that the market produces a number of varieties which is too small with respect to the socially desirable one. On the other hand, the above-marginal-cost pricing and the resulting pure profit stimulate entry and thus generate a tendency towards the production of too many products.

The relative strength of these two forces are likely to be affected by the existence of heterogeneous costs. Note that in the traditional version of the monopolistic competition model entry continues until profits are driven to zero. This does not happen in our model where, despite the fact that entry does reduce profitability, the long-run equilibrium is one where non-marginal firms make positive profits. Therefore, the strength of the second force mentioned above is bound to be smaller than when entry continues until profits are driven to zero. As a result, there is less scope for an over-production of varieties than when costs are homogeneous. Furthermore, as was highlighted in Section 3.6 where the steady-state of the heterogeneous industry was compared to that of the homogeneous costs one, there is an endogenously determined link between efficiency and concentration in the former which is lacking in the latter. This link was identified as being the source of the higher concentration of the asymmetric industry. In turn, this means that the first force mentioned above - which generates a tendency to under-produce varieties with respect to the social optimum - may indeed be stronger in this case than in the uniform costs situation.

To assess these intuitive points, we proceed to carry out the following exercise.

Given the heterogeneous cost technology, let us assume that the social planner knows that the steady-state will be characterized by a given efficiency cut-off point at which the marginal firms break even. Further, let the planner's choice variable be the number of firms (N^{o}) where the superscript *"o"* stands for *optimum.* Total industry welfare will then be maximized subject to an oligopolistic price constraint. More precisely, and similar to Spence (1976) whose constraint is given by the monopolistically competitive pricing, the constraint here will consists of the price index being equal to the one observable in the market steady-state (P^{**}). Note that from equation *(3.23)* this amounts to imposing an **efficiency constraint** on the social optimum, *i.e.* $\beta^{o}=\beta^{**}$, because the efficiency cut-off point in the constraint will be given by equation *(3.24)*. The disadvantage of this approach is that the role of prices in determining the optimum market equilibrium is ignored. As a result, only the optimality of the number of varieties can be assessed. Therefore, the solution to this problem will tell us whether the market number of varieties is optimal or not, given the equality of prices in the two situations being compared. To state it differently, we shall examine the case in which the social planner determines the welfare maximizing number of firms given the (market determined) steady-state range of technologies observed in the market.

The main advantage of this approach is that it allows for full and direct comparability between the market structure emerging from the working of competition and the optimal one, given the indenticality of prices. Thus, the social planner will choose the number of firms N to maximize

$$W^{\Delta} = W + \frac{N}{P^{**}} \int_{1-\delta}^{\beta^{o}} \left[\frac{\varphi A}{N^{o}} P^{**\sigma-\eta}\, \beta_{i}^{1-\sigma} - K\right] \frac{1}{\beta^{o}-1+\delta}\, d\beta \qquad (3.71)$$

$$s.t. \qquad \beta^{o}=\beta^{**}$$

where β^{o} is the cut-off point as perceived by the planner, β^{**} is given by equation *(3.24)* and W is defined in equation *(3.64)*[26].

The solution to the above maximization problem is given by

$$N^{o} = \left\{\frac{K}{A}\, P^{**\eta-1}\, (\sigma-1)\right\}^{(\sigma-1)/(2-\sigma)} \tag{3.72}$$

where P^{**} is given by equation *(3.23)*. By evaluating[27] the following second order condition

$$\frac{d^2W^{\Delta}}{dN^2} = \frac{2-\sigma}{\sigma-1}\,(\sigma-1)^{-1}\,A\,P^{**-\eta}\,\left(N\right)^{[(2-\sigma)/(\sigma-1)]-1} \tag{3.73}$$

at N^{o} we find that $\dfrac{d^2W^{\Delta}}{dN^2}<0$ for $\sigma>2$, but is positive for $\sigma<2$. Hence, N^{o} is a maximum only for values of σ greater than 2, which shall be assumed in the following analysis.

Numerical evaluation of equation *(3.72)* - for an illustration see Figure 3.20 - shows that, *ceteris paribus*, the optimal number of firms is a monotonically decreasing function of σ and is increasing in δ. Note that $(dN^{o}/d\sigma)<0$ is consistent with the relationship observable in the market steady-state where $(dN^{**}/d\sigma)<0$. This is easily explained by considering that as σ increases the degree of substitutability of varieties for one another increases, reflecting a lower value attached to variety by consumers. Hence given a **lower need** for variety, the optimal number of varieties is smaller the

---

[26] For simplicity, we assume that the two welfare components enter the social welfare function with the same weight. Hence the absence of weights in equation *(3.71)*.

[27] Evaluations have been carried out for $\delta=(0.01,\ldots,0.99)$, $\sigma=(1.5,\ldots,11.3,\ \sigma\neq2)$ and $\eta=(0.4,\ldots,1.3)$.

larger is σ. The relationship between N^{o} and δ, however, is not consistent with $(dN^{**}/d\delta)<0$. This suggests that, other things equal, as δ increases, the market **under-produces** varieties with respect to what is desirable from the welfare point of view. The positive relationship between the optimal number of varieties and the degree of technical heterogeneity between firms may perhaps be explained by considering that as δ increases the average industry efficiency (which in the social welfare problem is the same as in the market) increases and the price index falls. For any given σ, the higher is the industry efficiency the higher is the extent of differentiation consumers can achieve.

> **Proposition 3.6:** At the optimum constrained by the heterogeneous industry prices 1) there are more products than in the market equilibrium and 2) profits are negative.

Our comparison between the market and the optimal number of firms does suggest that the industry under-produces the socially optimal number of varieties. We have computed the ratio $\frac{N^{**}}{N^{o}}$ and it turns out to be smaller than unity for all values of the relevant parameters (see Figure 3.21). In particular, within the intervals we have considered, there is no value of $0<\delta<1$ for which $\frac{N^{**}}{N^{o}} = 1$. This implies that contrary to the majority of studies which suggest that under Chamberlinian monopolistic competition the market tends to overproduce varieties, this analysis suggests that market equilibrium is always characterized by a less than optimal number of varieties. This is obviously due to the relationship between efficiency and concentration we have highlighted in this study. In fact, the extent of **sub-optimality** is directly related to the size of δ, with $\left[\frac{d(N^{**}/N^{o})}{d\delta}\right]<0$.

Finally, note that the optimization problem discussed above differs from the constrained optimization in the usual sense. In general, a constrained or second-best optimum is one where the planner lacks the ability to carry out lump-sum transfers to compensate for the losses associated to a firs-best optimum in a situation characterized, as this one, by decreasing average costs. Clearly, as argued by Dixit and Stiglitz (1977), if there are increasing returns a first-best optimum may not constitute an appropriate strategy given that it would correspond to the equality between the individual firm price and its marginal cost; this, in turn, would imply that firms make losses[28]. Hence, the plausibility of this scenario would rest on the ability of the planner to make lump-sum transfers to firms to cover losses. If this ability is lacking, then the planner has no choice but to maximize social welfare subject to a break-even constraint, in which case the social optimum represents a second-best solution. However, the efficiency constraint imposed above does not ensure that the optimum number of varieties can be produced at non-negative profits. Indeed, by evaluating the expected surplus profit of equation *(3.26)* at N^{o} it can be shown that $E\left[\Pi_i(N^{o})\right]<0$ for all values of the relevant parameters[29].

[28] Note that within our framework, where there exists a distribution of firms' marginal costs, there would be a **dispersion** of the size of the losses incurred by firms.

[29] An alternative exercise would be to determine the number of firms so as to maximize the social welfare function subject to the marginal firms making non-negative profits. This would clearly involve greater computational difficulties.

3.11. CONCLUSIONS

This chapter has analyzed the implications of technical heterogeneity amongst firms for the market structure of a monopolistically competitive industry. By allowing for efficiency differences amongst firms, the model has provided a formal treatment of elements contained in Chamberlin's original work. The analysis of a horizontally differentiated product market has been carried out within a partial equilibrium framework where the dispersion of firms' efficiencies within the industry is generated by an exogenously given random process. Market structure has been determined endogenously and the existence of efficiency gaps and the uncertainty faced by potential entrants have been identified as the factors limiting rational entry. The analysis suggests that the resulting long-run equilibrium is not characterized by the elimination of long-run profits, and finds a relationship between concentration and profitability which is consistent with empirical findings. It is shown that the standard monopolistic competition model based on identical firms does not yield this result.

The steady-state implications of entry have been discussed and compared to those stemming from the traditional assumption of homogeneous firms. Some comparative welfare analysis of the two models has also been carried out. Whether or not the existence of a state of technology characterized by a high variability in firms' levels of efficiency can lead to a higher consumers' welfare than a situation characterized by a higher degree of homogeneity, depends on the relative efficiency in the two industries. This implies that, for instance, government policies aiming at diffusing technical knowledge and thus leveling out technical differences amongst firms could result in an increase in welfare only if the convergence to a common efficiency level was achieved through a general **increase** in efficiency.

Given the increasing use of the monopolistic competition model in other areas of economics, with positive as well as normative concerns, the relevance of this analysis goes beyond the industrial economics literature. In the remainder of this work we shall examine the implications of this analysis for international trade.

Appendix 3.1

THE CHOICE OF PRICE INDEX

The specification of the price index usually adopted in the monopolistic competition model in the industrial organization and trade literatures is derived from consumer preferences because it is dual to a quantity index *(D)* which is identical to the Dixit-Stiglitz utility function given by equation *(3.1)*.

In this Dixit-Stiglitz-Krugman (henceforth *D-S-K*) literature, it is argued[30] that consumers' love for varieties generates a divergence between the **physical** and the **true** levels of output, as they are perceived by consumers. This divergence results in the choice of a quantity index which takes into account the value of diversity. The task of representing the basket of goods purchased by the aggregate consumption sector - so as to take into account the degree of diversity of available products - falls on the utility function which can serve this purpose by virtue of its separability property.

The price index which is dual to this aggregate demand - or basket of goods - is given by equation *(2.18)*. This is can easily be proved. By solving the following optimization problem

$$Max \quad U = \left(\sum_{i=1}^{N} D_i^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)}$$

$$s.t. \; M = \sum_{i=1}^{N} P_i \, D_i \qquad (A3.1)$$

30 See for instance Krugman (1982).

where M stands for nominal income, we obtain

$$D_i = M\ P_i^{-\sigma} \left(\sum_{i=1}^{N} P_i^{1-\sigma} \right)^{-1} \tag{A3.2}$$

Letting $M = \hat{P}\ \hat{D}$ where $\hat{P}$ is the price index and $\hat{D}$ is the quantity index, and **assuming** $\hat{D} = U$, equation *(A3.2)* can be substituted into the utility function to yield

$$\hat{P} = \left(\sum_{i=1}^{N} P_i^{1-\sigma} \right)^{1/(1-\sigma)} \tag{A3.3}$$

which clearly corresponds to the price index in equation *(2.28)*. The *D-S-K* price and quantity indexes have an important implication. When all firms have the same costs, all varieties are sold in the same quantity and at the same price, that is $D_i=\bar{D}$ and $P_i=\bar{P}$ for all $i=1,...,N$. Hence, in the homogeneous firms case, $\hat{D}$ and $\hat{P}$ can be respectively written as

$$\hat{D} = \left(N\right)^{\sigma/(\sigma-1)}\ \bar{D} \tag{A3.4}$$

$$\hat{P} = \left(N\right)^{1/(1-\sigma)}\ \bar{P} \tag{A3.5}$$

Clearly, because of the "correction" for the value of product diversity, $\hat{D} \neq N\ \bar{D}$ and $\hat{P} \neq \bar{P}$. In other words, the *D-S-K* quantity index does not merely reflect physical output and the price index does not merely reflect the level of cost efficiency characterizing the industry. Instead, for any given equilibrium price P_i, the "perceived" price index would be lower the larger is the number of varieties.

This standard specification of the price index may be appealing in situations where consumers facing a wider choice - say as a result of trade - may be induced to change their income allocation across different goods. Clearly, not only does the **share** of expenditure on the differentiated good depend on prices and income, but also on the utility level that can be achieved from purchasing the good and this can be captured by the *D-S-K* price index.

In the framework in which we are working in this thesis, however, the possibility that consumers may revise their share of expenditure on the differentiated good does not arise, because the first stage of utility maximization is omitted and an exogenously given expenditure function has been assumed. Furthermore, given the emphasis in this study on the role of competitive selection in determining industry efficiency, and - in the following chapters - on the role of trade liberalization in affecting efficiency, we prefer to adopt a specification of price index which merely reflects technical efficiency **without correcting** for the value of varieties. In other words, we choose a price index which reflects the **actual** and not **perceived** purchasing power of consumers, as resulting from the (endogenously determined) state of efficiency in the industry.

The price index we choose is given by equation *(3.3)*, that is

$$P = \left(\frac{1}{N} \sum_{i=1}^{N} P_i^{1-\sigma} \right)^{1/(1-\sigma)} \qquad (A3.6)$$

Clearly, equation *(A3.6)* implies that when $P_i=\bar{P}$ for all i, $P=\bar{P}$. The price index merely reflects the level of cost efficiency of the firms in the industry. It is obvious that this price index is no longer dual to the *D-S-K* quantity index. Note that

$$P = \left(\frac{1}{N}\right)^{1/(1-\sigma)} \hat{P} \qquad (A3.7)$$

In the *D-S-K* framework, $\frac{M}{\hat{P}} = \hat{D} = U$. Therefore, from equation *(A3.7)* it follows that

$$\frac{M}{P} = D = \left(N\right)^{1/(1-\sigma)} \hat{D} \qquad (A3.8)$$

This clearly implies that $D \neq U$, that is

$$D = \left(N\right)^{1/(1-\sigma)} \left(\sum_{i=1}^{N} D_i^{(\sigma-1)/\sigma}\right)^{\sigma/(\sigma-1)} \qquad (A3.9)$$

From equation *(A3.9)* it is easy to see that when firms are homogeneous and $D_i=\bar{D}$ for all i, the quantity index for the differentiated industry simply reflects the overall **physical** output, that is $D = N\ \bar{D}$.

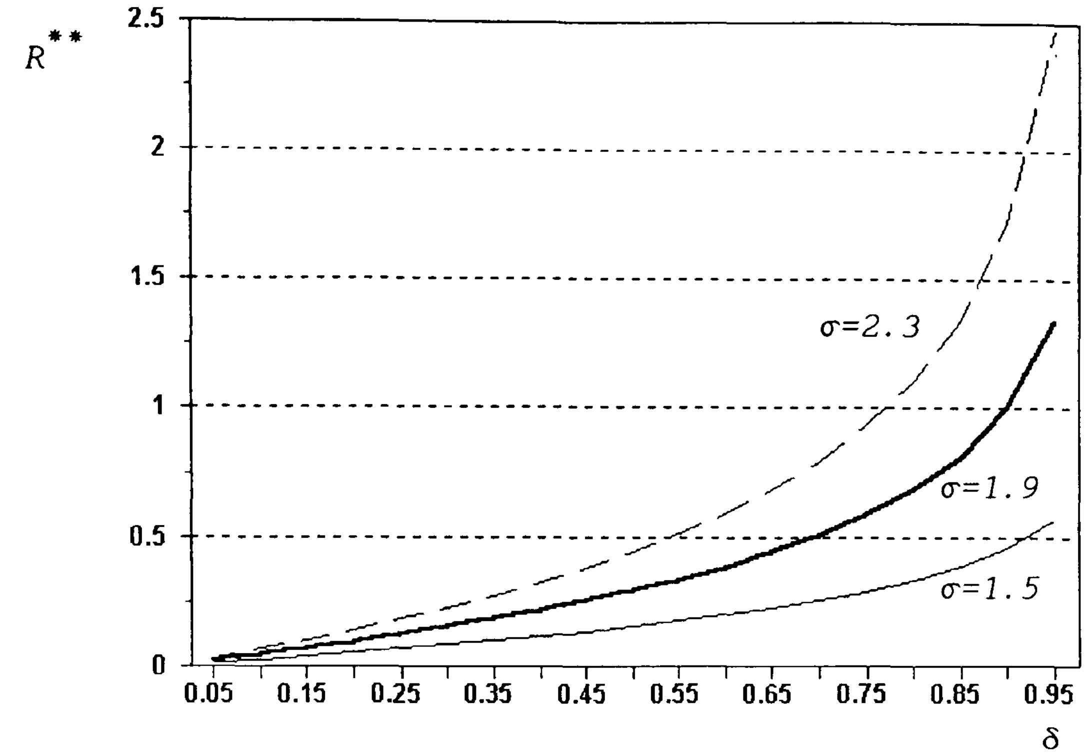

Fig. 3.3 Firm's steady-state expected profit

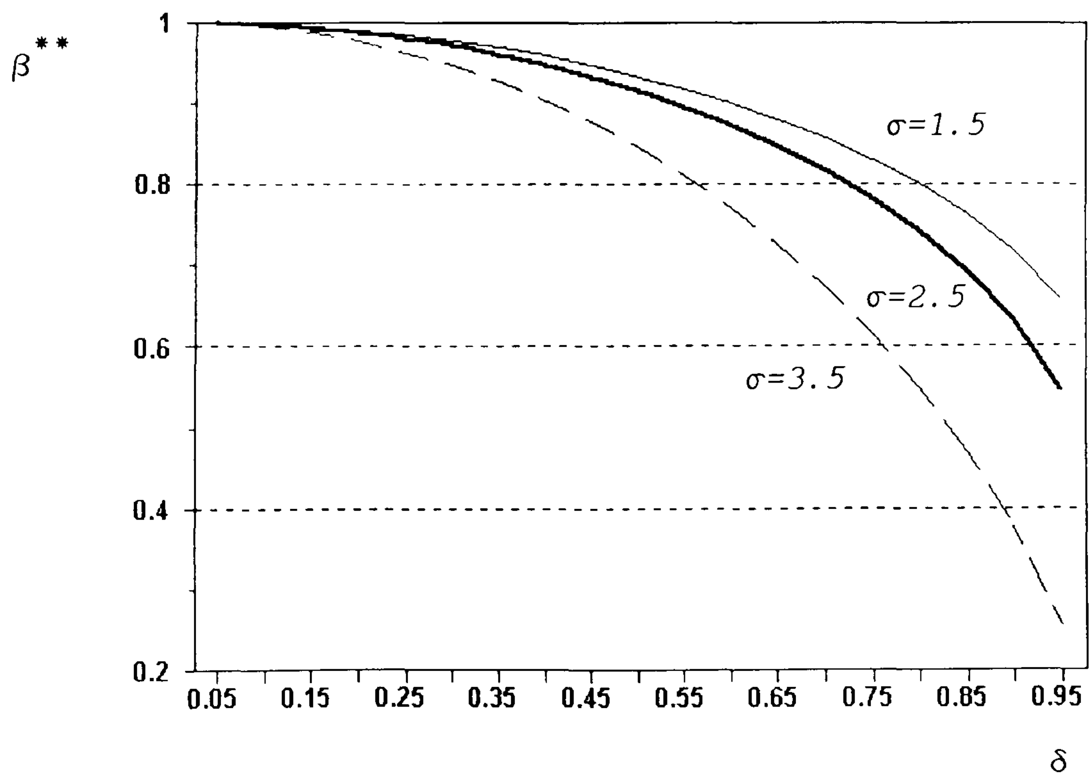

Fig: 3.4 Steady-state efficiency cut-off point

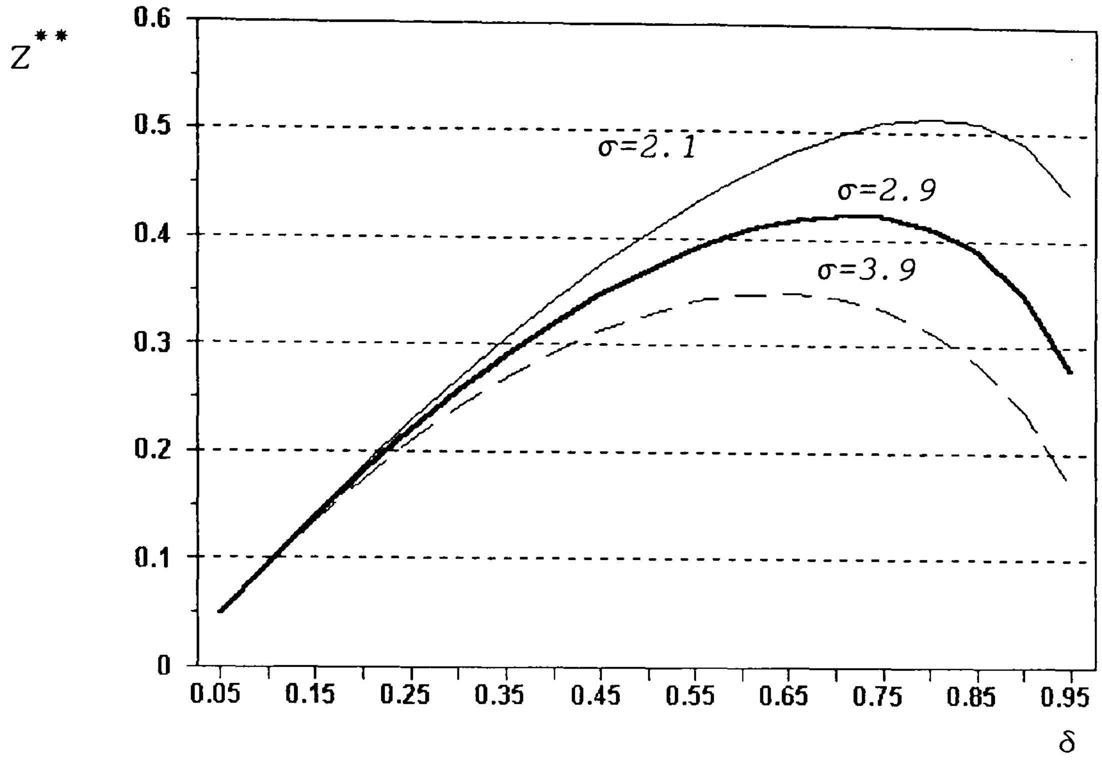

Fig. 3.5 Steady-state number of types of technologies

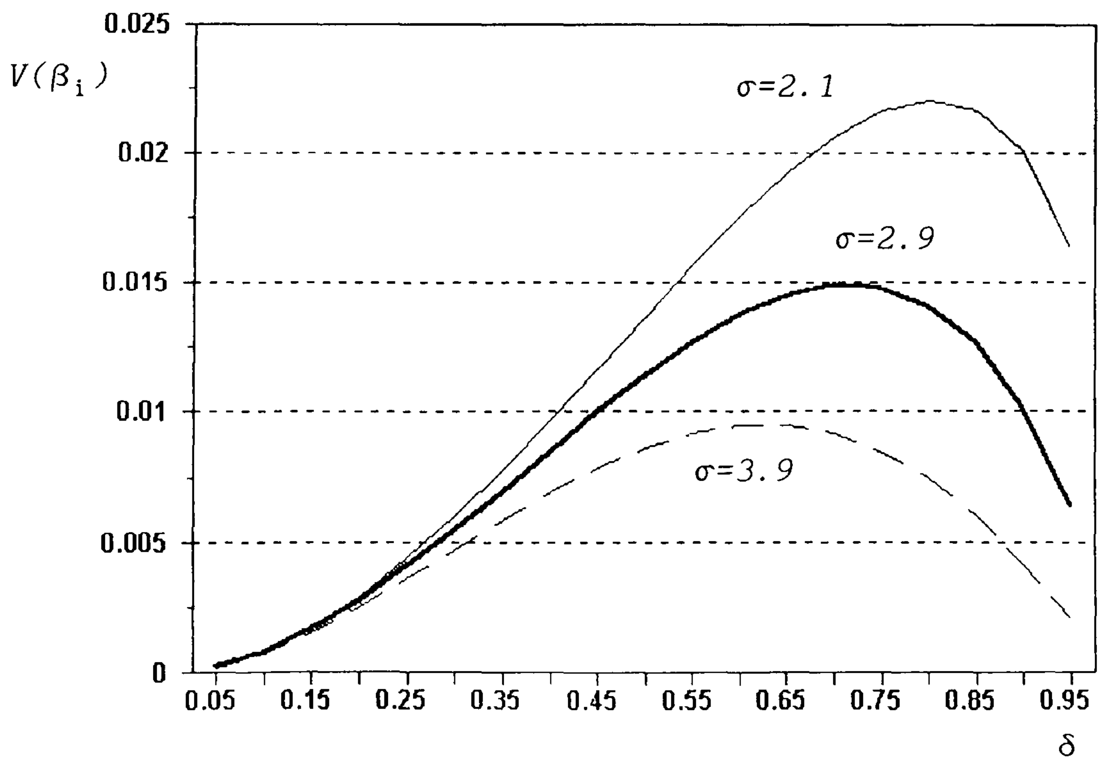

Fig. 3.6 Steady-state marginal cost variability

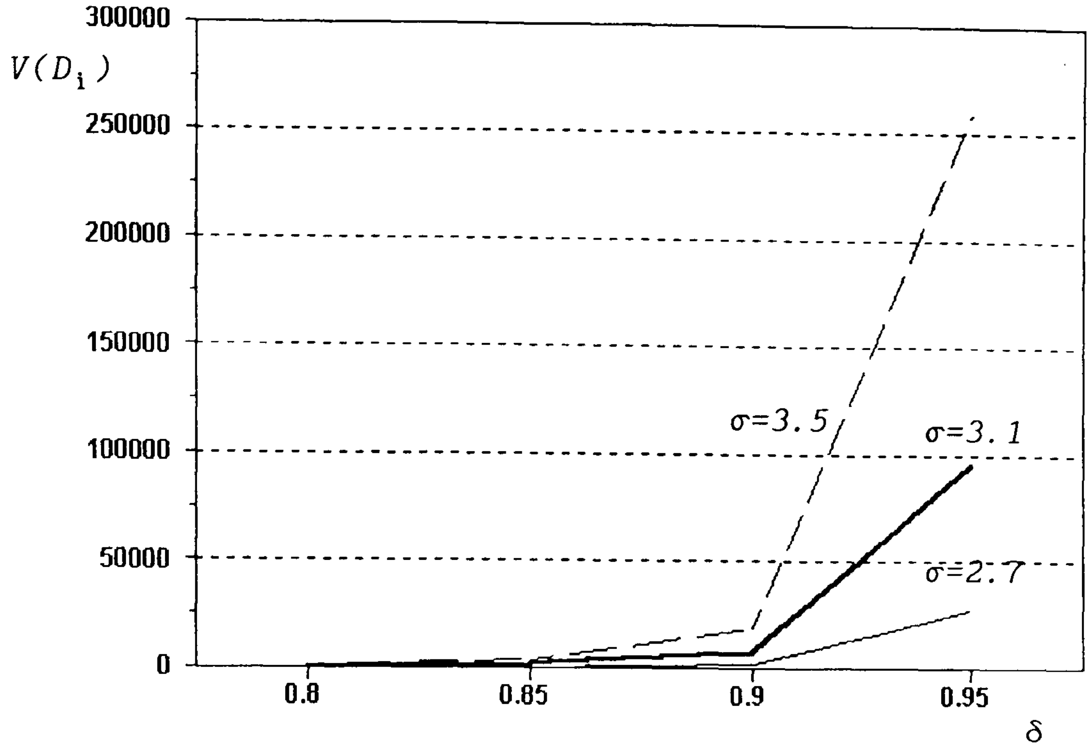

Fig. 3.7 Steady-state output variability

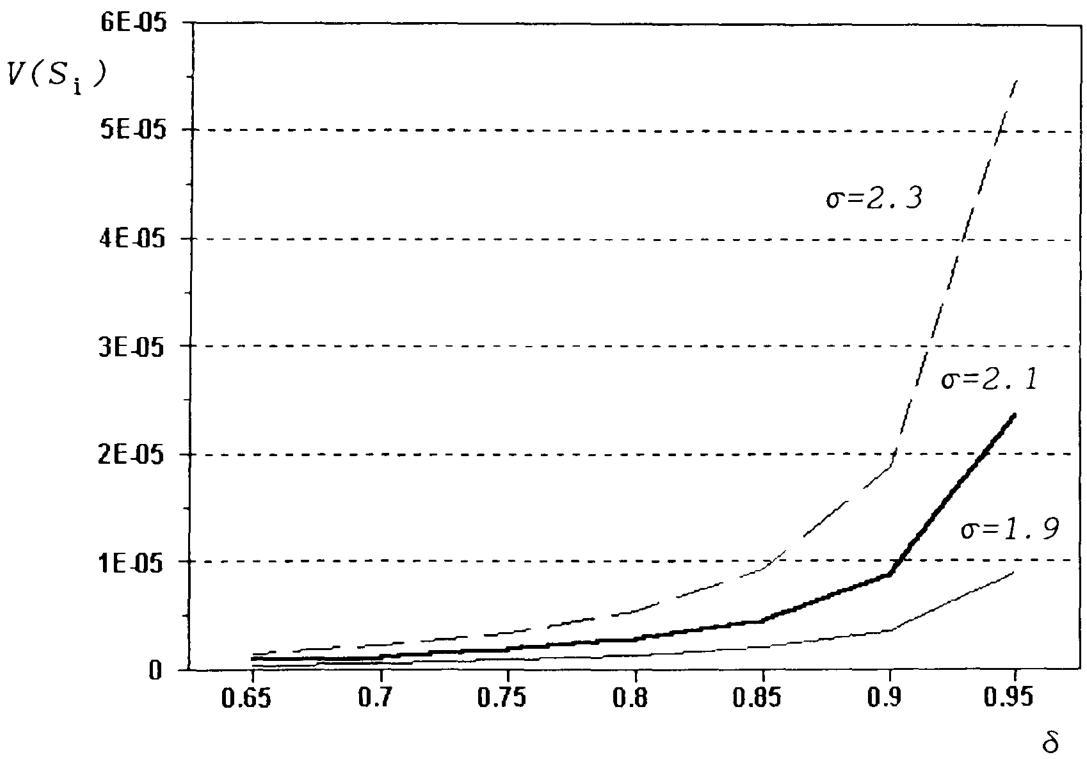

Fig. 3.8 Steady-state market share variability

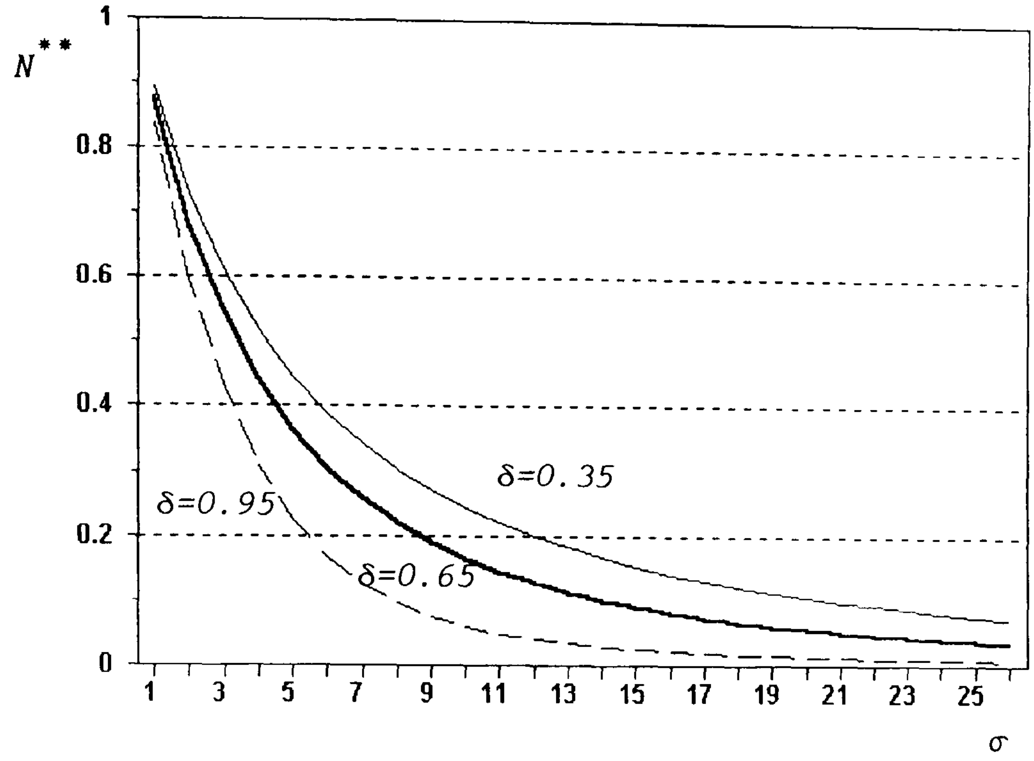

Fig. 3.9 Steady-state number of firms

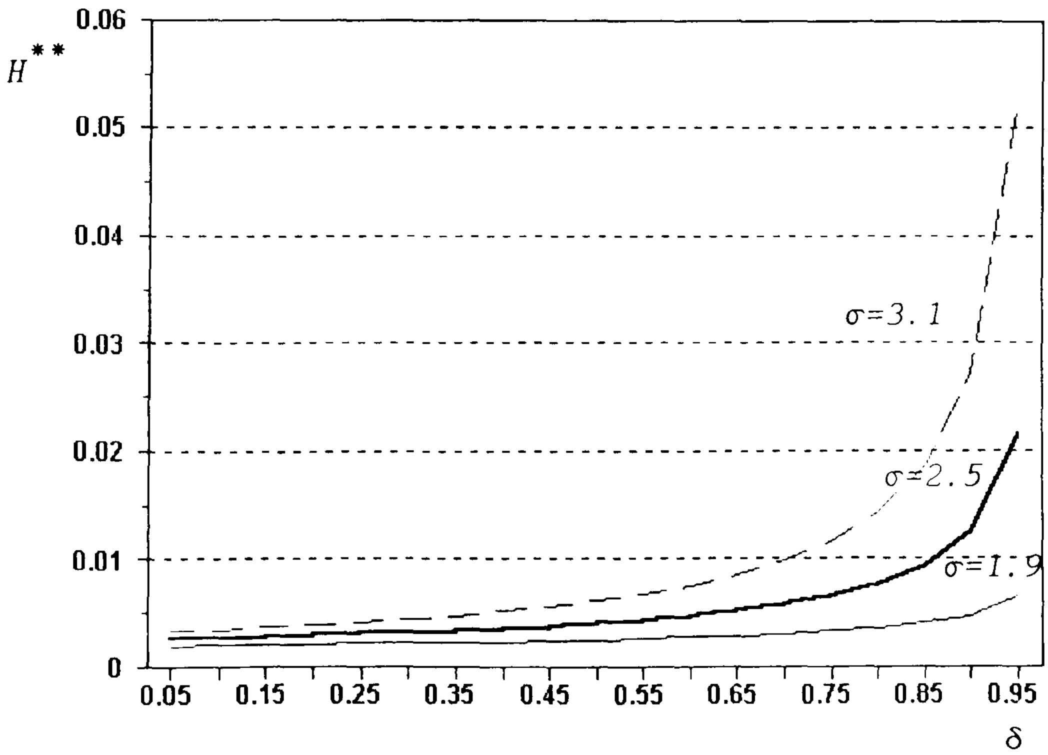

Fig. 3.10 Steady-state industry concentration

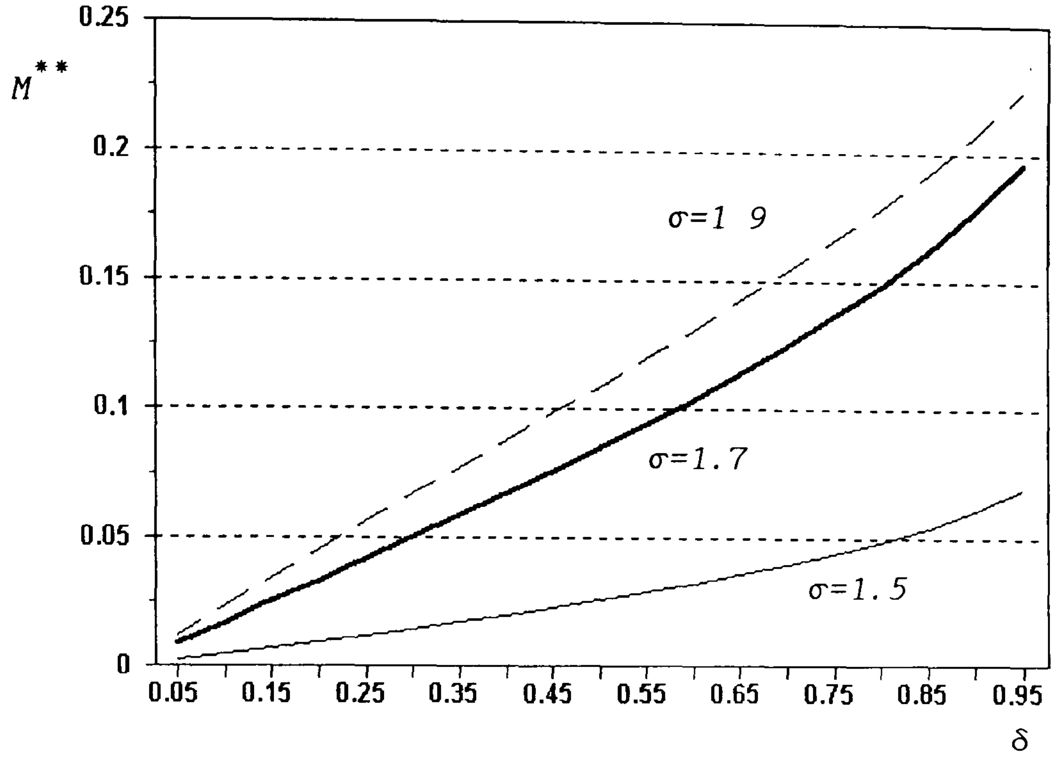

Fig. 3.11 Firm's steady-state expected profit margin

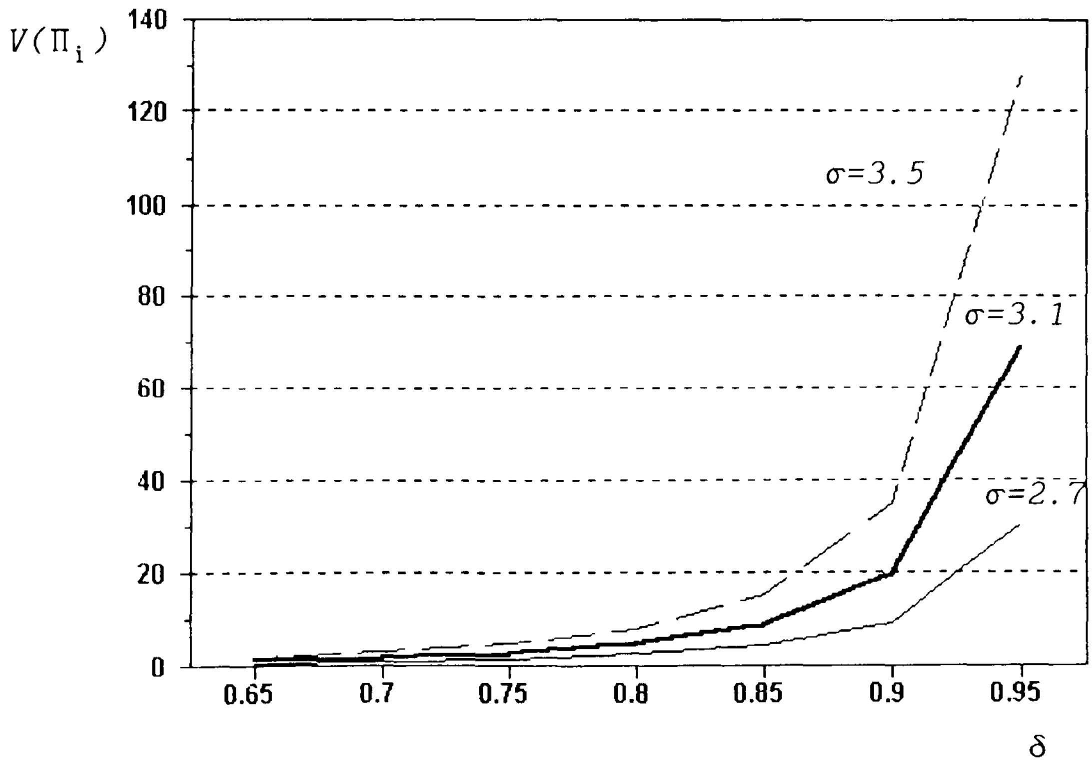

Fig. 3.12 Steady-state profit variability

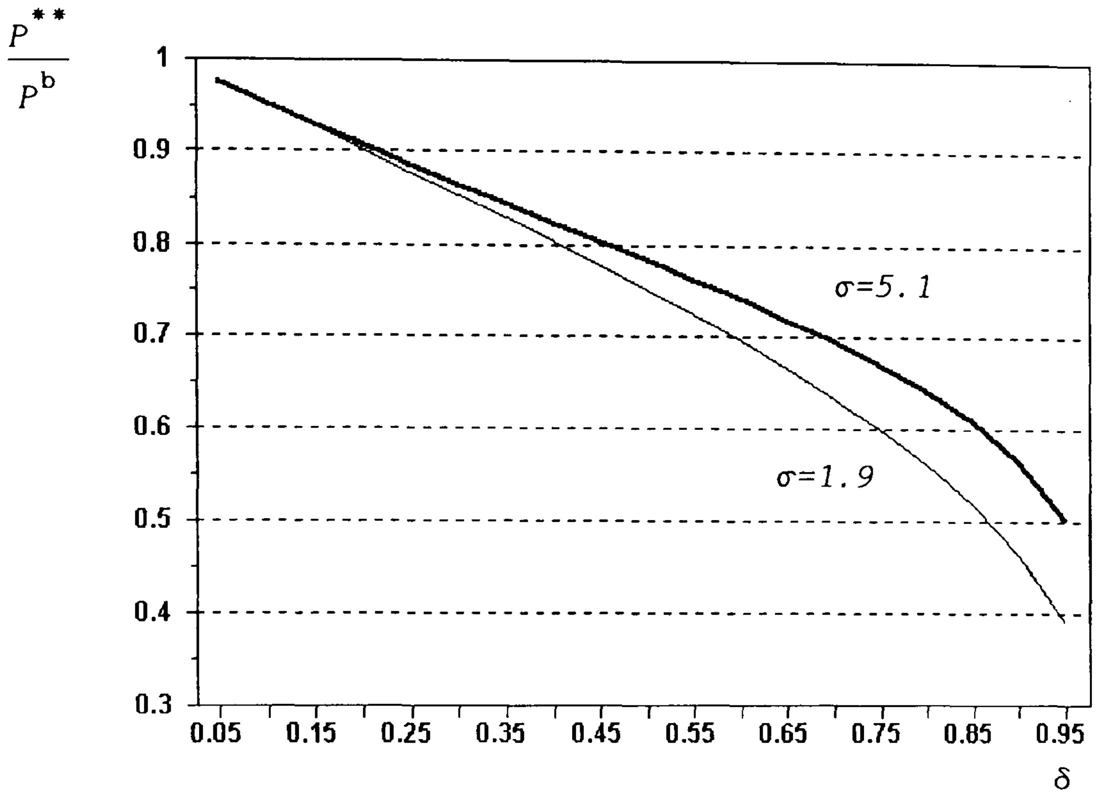

Fig. 3.13 Industry evolution: The price index

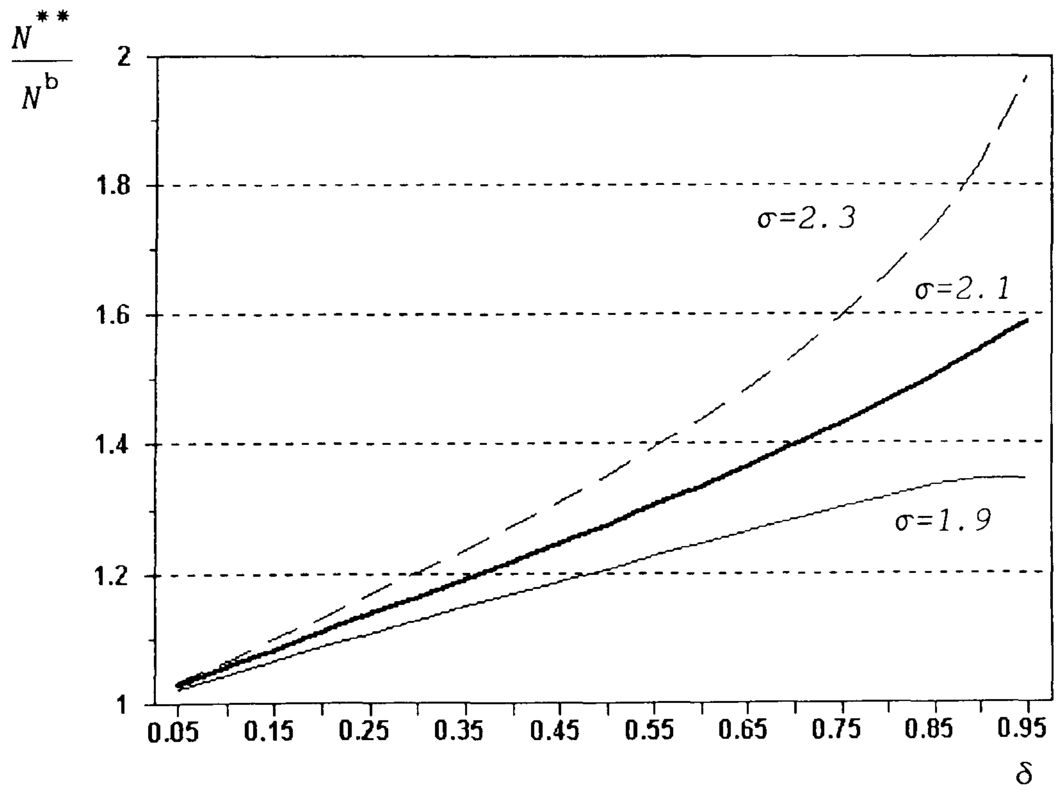

Fig. 3.14 Industry evolution: The number of firms

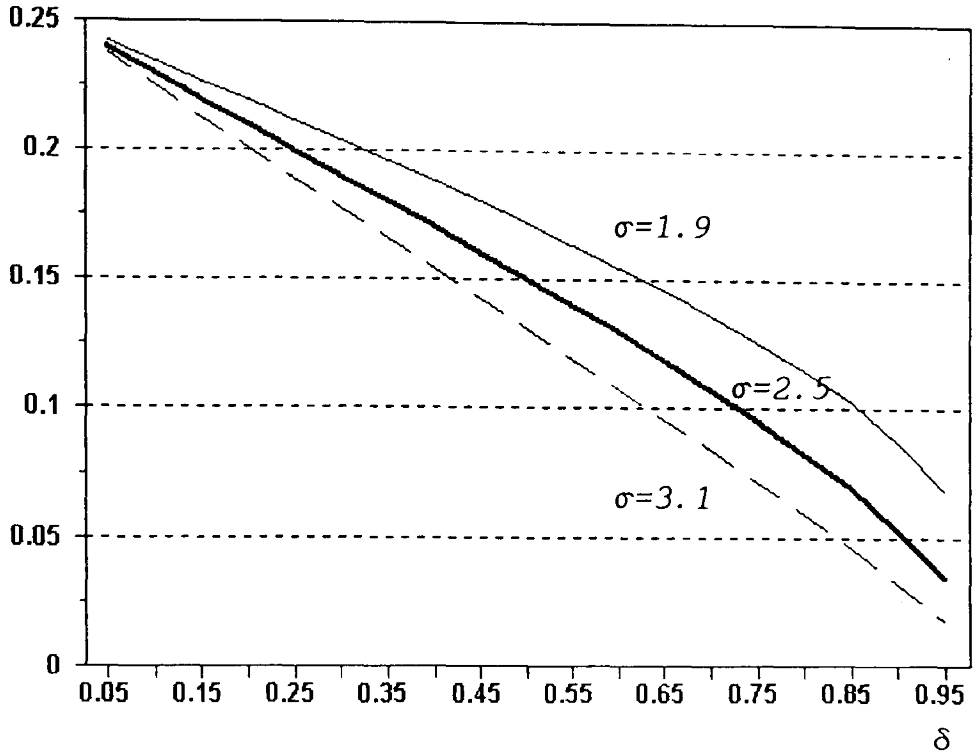

Fig. 3.15 Industry evolution: Marginal cost variability

(Steady-state over "origin" variability)

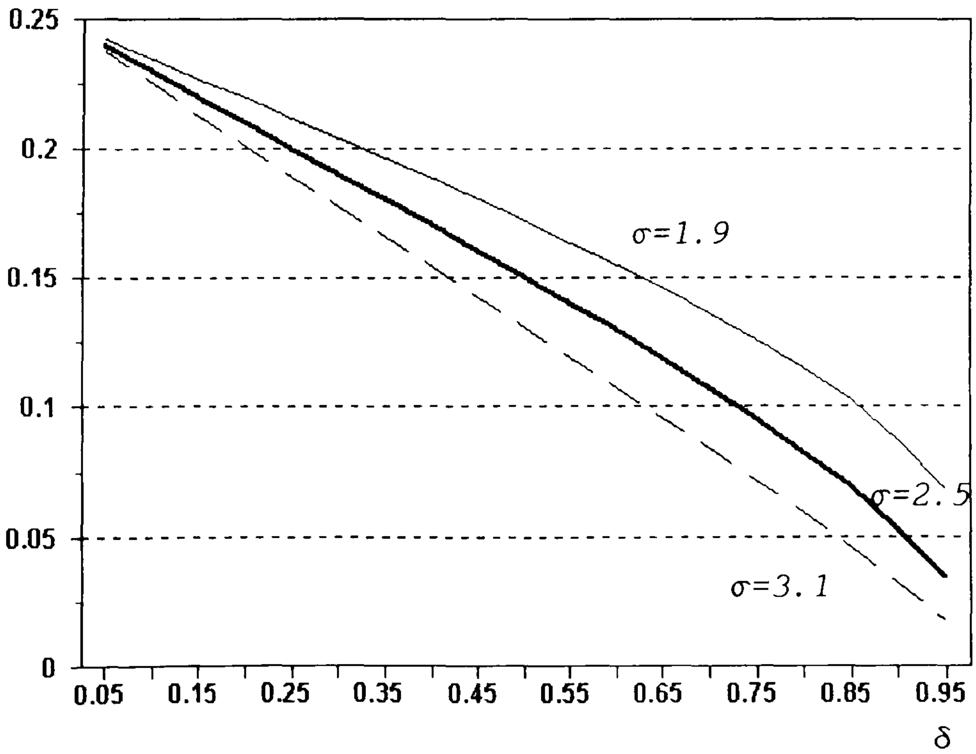

Fig. 3.16 Industry evolution: Price variability

(Steady-state over "origin" variability)

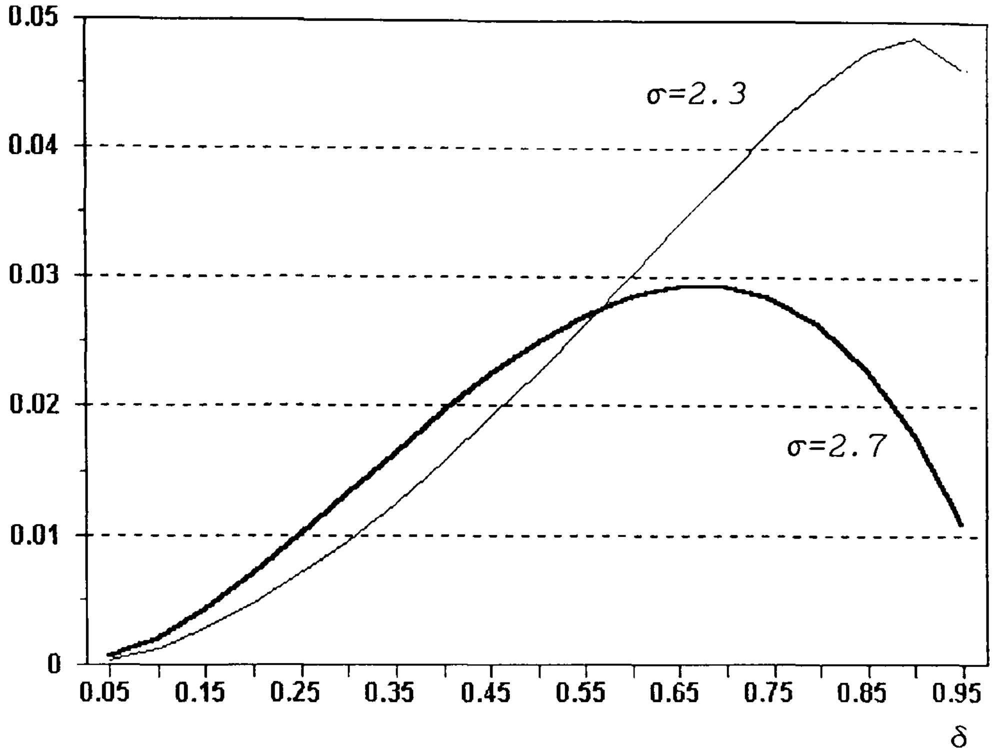

Fig. 3.17 Industry evolution: Market share variability

(Steady-state over "origin" variability)

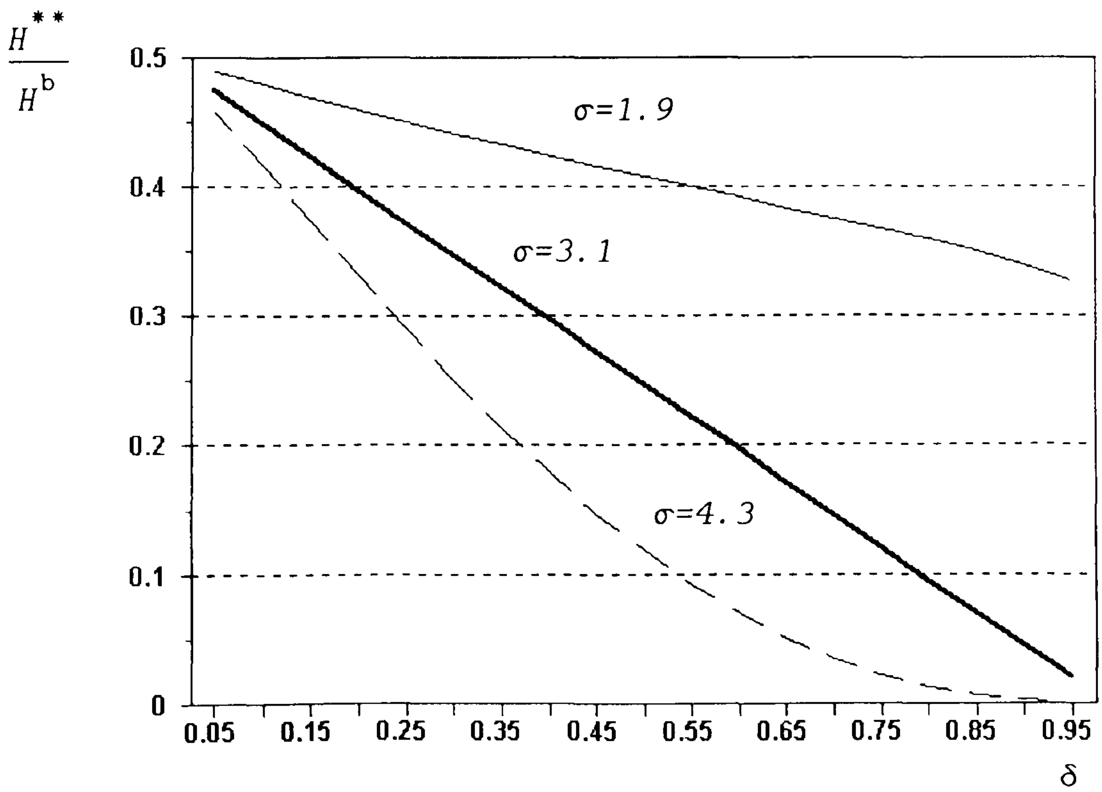

Fig. 3.18 Industry evolution: Industry concentration

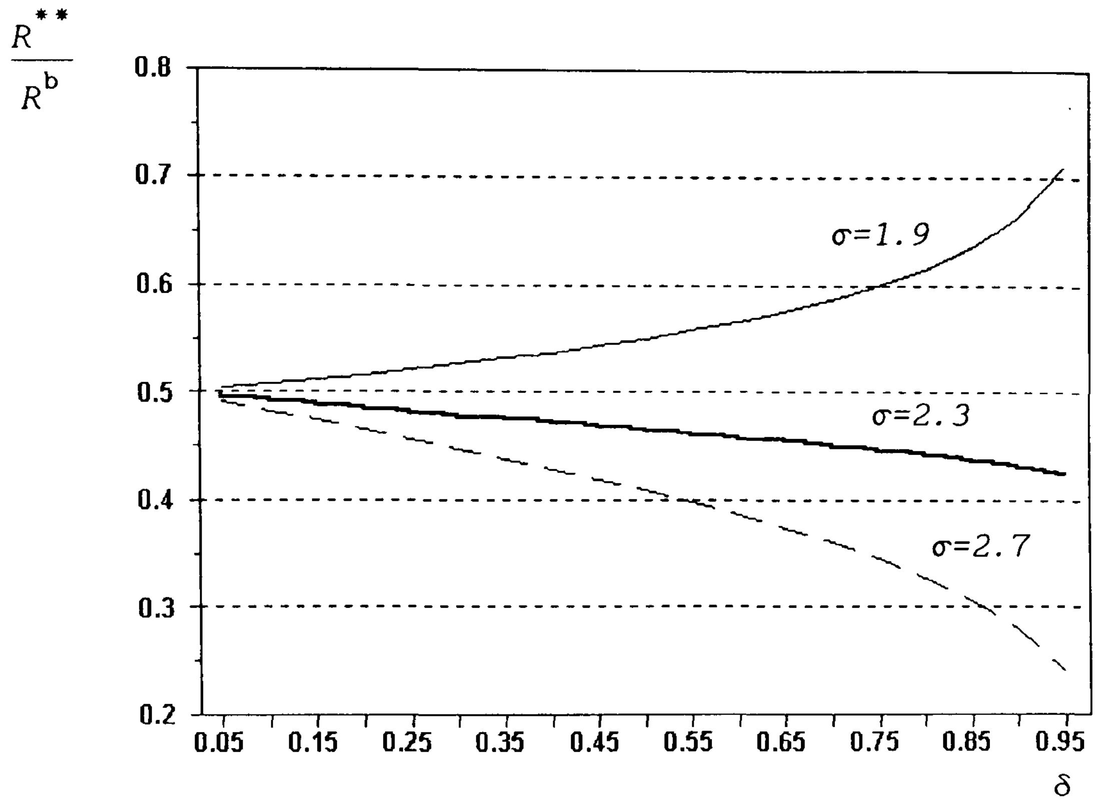

Fig. 3.19 Industry evolution: Expected profit

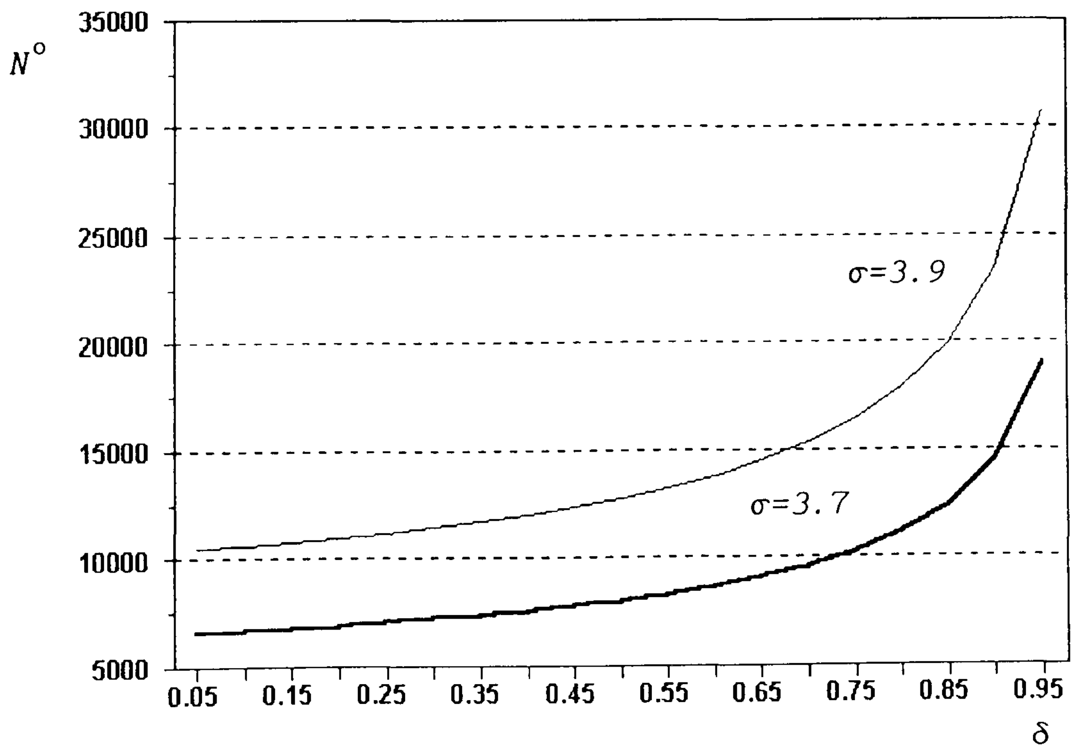

Fig. 3.20 Optimal number of firms

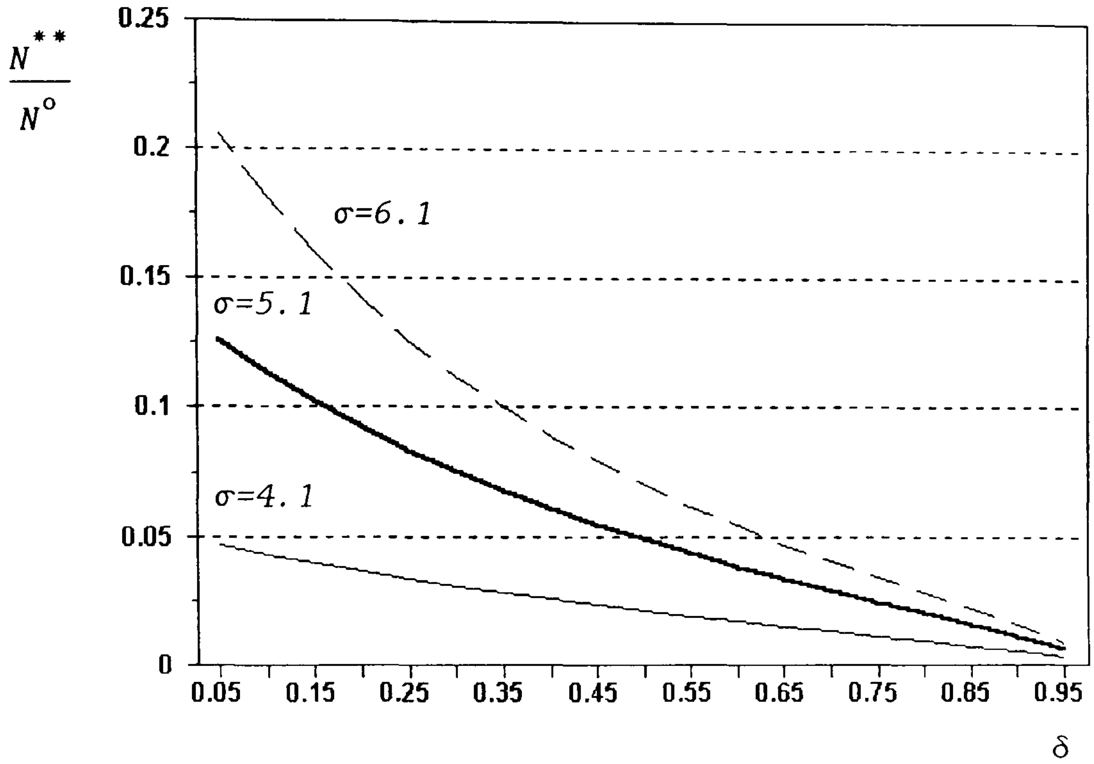

Fig. 3.21 A sub-optimal market solution

Chapter 4

MONOPOLISTIC COMPETITION IN INTERNATIONAL TRADE THEORY

"There is no branch of economics in which there is a wider gap between orthodox doctrine and actual problems than in the theory of international trade"

Joan Robinson, 1973

4.1. INTRODUCTION

Recent developments in the theory of international trade, starting with the work of Krugman (1979a, 1980, 1981), Helpman (1981) and several others, have provided explanations of the patterns of international specialization alternative to those stemming from comparative advantage theories of trade, according to which countries trade in order to take advantage of their differences. Models based on imperfectly competitive market structures, utility functions that reward product diversity and increasing returns to scale technologies have established a rationale for the so called **intra-industry-trade** which accounts for a great deal of manufacturing trade, in particular amongst industrial economies.

The body of literature which has emerged in the area is extremely vast. Our aim in this chapter is not to provide an exhaustive overview of this theory but only to analyze the main aspects of those areas which bear significant relevance to the more limited aims of this study. Hence, particular attention will be paid to the monopolistic competition strand of the theory, focusing on the part developed within the Chamberlinian framework[1].

One of the main results of the analysis developed in Chapter 3 is that allowing for inter-firm cost heterogeneity within the standard monopolistic competition model *à la* Dixit and Stiglitz has the implication of endogenizing the steady-state industry efficiency level. As was anticipated at the end of that chapter, our intention is to extend this framework to an international trade setting on the basis of the belief that this will indeed change the standard predictions of models of trade set in a monopolistically competitive framework. Before doing so, however, it is essential to review the predictions of the existing literature.

In the course of this chapter we shall argue that the current literature is based on assumptions which weaken the ability of the resulting theoretical models to explain certain aspects of real world markets which are evident even on casual observation.

Three are the main aspects on which the analysis will impinge: (1) trade patterns, (2) welfare effects of trade liberalization, and (3) the rationalizing effects of free-trade. Furthermore, our account of the literature will not be heavily focused on trade policy issues which, despite our subsequent analysis of the welfare effects of trade liberalization, is not amongst the main aims of this work.

4.2. TRADITIONAL TRADE THEORY AND UNEXPLAINED FACTS

The main concerns of the theory of international trade have not changed over the years and can be summarized by two related issues.

---

1 Excellent surveys of the so called new trade theory are offered by Jones and Neary (1984), Helpman (1984b) and, more recently, Smith (1994).

First, the determination of the patterns of trade. Second, the identification of the sources of gains brought about by trade and their distribution amongst countries. The theory of trade, although generating a huge body of literature, has been impressively consistent in terms of theoretical construction for over two centuries.

4.2.1. Assumptions and predictions of the "orthodox" theory of trade

The theoretical framework on which all the now so called traditional trade literature has been based is that of perfect competition. On the supply side, production technologies are characterized by constant returns to scale and diminishing marginal physical products to factors. Perfect homogeneity of goods is also assumed. On the demand side, consumers have homogeneous tastes described by identical homothetic utility functions. Hence, within each economy, the maximizing behaviour of price-taking agents ensures competitive equilibrium and market clearing in both goods and factor markets. Finally, no impediment is assumed to exist to the free movement of goods across countries. As far as factors of production are concerned, perfect mobility is assumed within countries but they are completely immobile internationally.

This homogeneity of hypotheses has led to homogeneity in the answers provided to the two main questions mentioned above. Countries trade in order to take advantage of their differences and the resulting patterns of international specialization will reflect the patterns of comparative advantage. In the Ricardian model, comparative advantages take the form of differences in the relative efficiency in production, with countries specializing in those goods in whose production they are relatively more efficient. In the Heckscher-Ohlin model, comparative advantages reflect differences in relative factor endowments. A trading country will specialize in the commodity whose production is intensive in the factor of which the country has a relative abundance. In both types of models, trade is explained by the existence of pre-trade differences in relative prices generated by either form of comparative advantage and generates welfare gains. These gains stem from the more general idea that perfect competition promotes an efficient allocation of resources by allowing the potential benefits of specialization to ripen. In essence, specialization will enable countries to consume outside their production sets[2].

4.2.2. Unexplained facts and new avenues

The Ricardian and the Heckscher-Ohlin models are significantly different. For instance, the Ricardian model, by assuming the existence of only one factor of production, cannot deal with the effects of trade on income distribution between factors. Distributional issues can instead be analyzed within the two factor Heckscher-Ohlin model where trade has effects on factor prices such that overall gains accruing to the country as a whole may be associated with real income losses of some groups within the country. Nevertheless, the predictions of these models in terms of patterns of specialization and welfare effects of trade are very similar in

[2] For excellent surveys on traditional trade theory see Jones and Kenen (1984) and Falvey (1994).

nature.

In particular, the explanation of trade by comparative advantage implies that trade between countries will be greater the greater are the differences between them. As pointed out in Chapter 1, this prediction is at odds with most of the evidence from the real world which suggests that the greatest bulk of world trade takes place between similar countries. Indeed, trade flows seem to be greater the more similar are the countries involved. Not only do Western Europe, North America and Japan offer location to the largest proportion of world economic activity, but their reciprocal trade flows account for the majority of world trade. Furthermore, a high proportion of trade occurring between industrial countries is intra-industry or two-way trade, that is it takes place within the same industry. Clearly, traditional trade theory cannot easily deal with these facts because it predicts that exports are generated by a comparative advantage and imports result from a comparative disadvantage. Intra-industry trade would imply the simultaneous existence of both within the same industry.

Major attention to the phenomenon of intra-industry trade was stimulated by Verdoorn's (1960) finding that trade between the Benelux countries, after the formation of the customs union in 1948, took place within rather than between different product groups, thus suggesting an intra-industry rather than inter-industry pattern of specialization.

Systematic research on the subject began with the work of Grubel and LLoyd (1975). These authors, however, stressed how the existence of intra-industry trade had been acknowledged before Verdoorn's study. Frankel (1943) found that countries with a high proportion of international trade per capita tend to export and import the same commodities. His explanation was based on the existence of product quality differences between exports and imports. In turn, differences in quality were explained by differences in labour skills. Basically, Frankel was putting forward what later became known as a vertical product differentiation hypothesis as an explanation of trade patterns. Hirschman (1945) found that the traditional type of international exchange - foodstuffs and raw materials against manufactures - did not account for more than one third of world trade during the years 1925-1937. Instead, about one fifth of world transactions was accounted for by manufactures-against-manufactures trade. Hirschman interpreted this as evidence of an international industrial division of labour.

Amongst the first reactions to the upsurge of intra-industry trade was the attempt to dismiss its relevance as a spurious statistical phenomenon. A number of studies such as Finger (1975), Lipsey (1976), and Rayment (1976, 1983) suggested that the two-way trade was basically a trade overlap. These authors pointed at the aggregation level of trade data as the source of the problem. Hence the observed intra-industry trade was the outcome of `categorical aggregation´ whereby items with differences in factor endowments were wrongly included within the same statistical category of products. If the proper differences in factor contents were taken into account, the validity of the Heckscher-Ohlin theory would be restored. Hence, there was no need for new theoretical developments.

4.3. NEW ASSUMPTIONS

More significant and constructive were the attempts to find suitable theoretical frameworks to analyze and explain intra-industry trade and the large proportion of trade occurring between similar countries. The search for theoretical underpinnings to these empirical facts proceeded towards the modification and/or the relaxation of the assumptions underlying the traditional theories. The main directions of research entailed a different view of industries, characterized by increasing rather than constant returns to scale, and/or producing heterogeneous rather than homogeneous products. Some of the new theories represent a major swing from the standard perfectly competitive framework to imperfectly competitive ones.

During the last two decades trade theory has generated a proliferation of models. To an extent, as often happens after a path breaking development, these have consisted of special extensions of few innovative contributions, each based on its own special assumptions *"seemingly inconsistent not only with traditional trade theory but with each other"* (Helpman and Krugman, 1985 page 1). However, during the the last fifteen years our understanding of international trade issues has been greatly enriched by a research effort which has produced a large range of theoretical developments each focusing on different aspects of real world trade. Never before had trade theory better responded to the warning of Ohlin (1933) that the claim that one specific theory could monopolize the explanation of international trade was unsustainable[3].

---

3 Helpman and Krugman (1985) offer a superb synthesis of this variety of models which are treated as special cases of a unified

4.3.1. Increasing returns

One of the main theoretical developments stimulated by the inability of traditional models to explain some of the main and increasingly important features of real world trade has been the incorporation of increasing returns to scale into trade theory. The fact that increasing returns are a feature of real world industries makes this development valuable *per se*. But its crucial importance is that the introduction of scale economies has indeed allowed to solve some of the problems of traditional theory in dealing with the empirical evidence on international trade.

The type of increasing returns assumed in the analysis should be specified with care because it affects the behaviour of firms, the nature of market structure and, through them, the patterns of trade.

The major distinction is between **external** and **internal** economies of scale. The rationale behind these two sources of increasing returns is different. The former is based on the argument that a large industry allows a better exploitation of the advantages of conglomeration as well as a better specialization of the production units within the industry. In this latter sense, the division of labour is limited by the extent of the market. More recently, a further justification for external economies of scale has emerged which is related to the incomplete appropriability of knowledge. Information gained by one firm either through **history** (experience) or intentional innovative activity (*e.g.* research and development) will spill-over and generate a positive externality on other firms in the industry and/or in competing countries. Hence, the static external

framework.

effects model can be regarded as a good approximation to more complex situations. Instead, scale economies internal to the firm can be explained on the basis of specialization advantages internal to the organization which emerge in presence of indivisibilities or non-convexities.

4.3.1.1. External increasing returns

Until the late seventies, theoretical attention had mostly been confined to external economies of scale. Typically, economies of scale external to the firms but internal to the industry can be represented by a production function of the form

$$Q_i = f\ (v,\ Q) \tag{4.1}$$

where the subscript i denotes a firm in the industry, v is a vector of inputs and Q is the industry's level of output. The function $f(\cdot)$ is assumed to be quasi-concave and positively linear homogeneous in v. As a result, for any individual firm the production process is characterized by constant returns to scale, that is $f(\lambda v,Q)=\lambda f(v,Q)$. The industry as a whole, however, exhibits increasing returns to scale. When all firms have identical production functions and face the same factor prices, increasing returns to scale at the industry level will exits when the elasticity of the production function $f(\cdot)$ with respect to total industry output is positive, that is $\frac{d\log f(\cdot)}{d\log Q}>0$.

In principle, the term Q in equation *(4.1)* could represent any external influence on the firm's output. In particular, the external effect does not need to be limited to **national** factors, but could be **international** (*e.g.* the size of the world industry) or **inter-industry** (*e.g.* the size of an industry producing intermediate goods used in the industry under consideration). The most common assumption in the literature is that of **national** increasing returns, whereby the productivity of firms in the industry is positively related to the total output produced in the domestic market.

The great theoretical advantage of assuming economies of scale external to the firm is that they are compatible with perfect competition. This may indeed explain the popularity of this assumption in trade models given its ability to offer plausible answers to some of the unexplained facts of trade while remaining within the framework of the traditional trade theory.

4.3.1.2. Internal increasing returns

Increasing returns to scale are internal to the firm if a small proportional increase in all inputs used in production leads to a more than proportional increase in output. Given a quasi-concave production function $Q_i=f(v)$, increasing returns to scale internal to the firm exist if $f(\lambda v)>\lambda f(v)$ for $\lambda>1$.

Larger firms will plausibly be better at overcoming indivisibilities and will thus be more efficient than smaller ones in the use of capacity. Given that often there are overhead costs independent of the scale of production, unit costs will fall with the level of output produced. The relevance of internal scale economies for international trade is obvious given the role of the latter in expanding the size of the market.

The crucial feature of economies of scale internal to the firm is that they are not compatible with perfect competition because they imply that marginal cost pricing generates losses, hence the need to to operate within market structures that allow prices to be above marginal costs. A departure from the perfectly competitive framework can occur in different fashions. Depending on other features of the industry and on the nature of the product, a variety of market structures may emerge, each with different predictive implications as to the emerging pattern and effects of international trade.

4.3.2. Product differentiation

To a great extent, theoretical explanations of intra-industry trade have relied on product differentiation. Idiosyncratic tastes imply that there exists in every country demand for a wide spectrum of varieties. Under free-trade, consumers will purchase goods produced in a foreign country if these are perceived to be different from the domestic varieties. As was argued in Chapter 2, preference structures which reward product diversity need to be supplemented by the existence of economies of scale in order to limit the number of varieties produced in the market. These two factors - product differentiation and economies of scale - will imply monopoly power and imperfect competition. Mainly, but not exclusively, this literature has been developed within monopolistically competitive frameworks.

4.3.3. Imperfect competition

Two quite separate bodies of literature can be identified in the new trade literature, one based on monopolistic competition and the other consisting of oligopolistic markets. The distinction is not merely due to the different nature of the market structures involved, but also stems from the role plaid by imperfect competition. It could be argued that in monopolistically competitive models, the imperfectly competitive market structure is not an aim *per se*, but stems from the need to incorporate internal economies of scale and product differentiation. Instead, oligopolistic models in general focus directly on imperfect competition as a determinant of trade pattern and - sometimes - use internal economies of scale as a necessary factor to generate the imperfectly competitive market structure. Common feature of these models is to show how market structure alone can explain trade patterns.

4.4. THE PERSISTENCE OF PERFECT COMPETITION: EXTERNAL ECONOMIES OF SCALE

Until recently, external economies of scale were the standard way to introduce increasing returns into international trade models.

National increasing returns are the most commonly assumed. The cost savings that a firm experiences as a result of the domestic output expansion allow to explain trade occurring between identical countries, which would not have any incentive to trade according to the comparative advantage hypothesis: international specialization will result from the advantage of large scale production stemming from trade.

The role of economies of scale in affecting trade patterns has long been recognized in the literature. Marshall, (1879) suggested that with increasing returns to scale trade may lead to terms of trade improvements by expanding a country's demand for imports.

Graham (1923) argued that a country with a sector characterized by increasing and one with decreasing returns to scale may lose from trade if trade shifts resources from the former to the latter, given the ensuing reduction of the output per-man in both industries. The first general-equilibrium treatment of increasing returns in international trade was probably provided by Lerner (1932). After noting that with increasing returns in all sectors the transformation curve can be convex to the origin, Lerner concluded that at least one country will have an incentive to complete specialization. Ohlin (1933) acknowledges that economies of scale may provide an explanation for the patterns of trade, in the sense that their mere existence may generate international exchange even in the absence of other causes. Formally, this was subsequently proved by Matthews (1949) and by Melvin (1969). The latter author showed that increasing returns to scale external to the firm would provide the basis for trade between identical countries[4].

More recently, Markusen and Melvin (1981) have demonstrated that not only can national economies of scale cause international trade, but they can also provide a link between trade patterns and relative country size. Within a *2x2x2* model in which only one good is produced with increasing returns to scale, a well defined relationships is found between country size, trade pattern and direction, and international factor price differences, with the large country exporting the good with increasing returns. Ethier (1982a) analyses

---

4 Jones (1968) examines the validity of the Rybczynski and Stopler-Samuelson theorems in the presence of economies and diseconomies of scale. This line of research is also pursued by Herberg and Kemp (1969), Mayer (1974) and Panagariya (1980). Given the more limited aim of this work, we shall not enter this debate here.

the role of national increasing returns within a Ricardian model and contradicts Graham's welfare result. There are two countries both producing two goods with identical technology and one factor of production. One of the two industries exhibits national external economies of scale while the other produces with constant returns to scale. The country with the larger industry in the increasing returns sector is shown to develop a comparative advantage in the increasing returns good which will lead to specialization. Indeed, increasing returns are the only source of trade. Note, however, that multiple equilibria arise in the model, some of which involving an incomplete specialization.

As in Ethier (1982a), in Pangariya (1981) labour is the only factor used in the production of two commodities. Here however, one good is characterized by increasing and the other by decreasing returns to scale external to the firm but internal to the industry. In a two country setting Panagariya obtains results - similarly to Markusen and Melvin (1981) - which suggest a relationship between country size and international specialization. Assuming that both economies are characterized by identical tastes and technologies but are different in size, the small country will be a net exporter in the decreasing returns good and the large country will be a net exporter in the increasing returns one. Furthermore, while the former may or may not specialize completely, the latter will never fully specialize[5].

[5] Panagariya also examines the case of a small open economy and finds that it will never fully specialize in the production of the increasing returns good, while this may happen in the good characterized by diseconomies of scale.

Ethier (1979) criticizes the nationally based external economies approach by arguing that in an internationally integrated market a firm experiences cost reductions when the world market for its products increases. In other words, it is the extent of the world market which limits the degree - and the advantages - of specialization and not the national one[6]. With a model where average costs are decreasing in the size of the international market, the contrast between inter- and intra-industry trade in intermediate manufacturing goods emerges from a wider standard Heckscher-Ohlin framework. Each country produces two commodities, manufacturing *(M)* and wheat *(W)*. The only difference between the two countries is in the shape of their production possibility frontiers. A concave production possibility frontier relates the scale of manufactures *(m)* to the output of wheat, that is $m=T(W)$. The manufacturing good is subject to scale economies, the extent of which is given by $k \equiv M/m$. Denoting the foreign country's variables with an asterisk, $k=(m+m^*)^{\alpha-1}$ with $\alpha>1$. Clearly, the degree of scale economies is a function of the scale of world manufacturing activities $(m+m^*)$. As a result, the relationship between W and m follows the standard Heckscher-Ohlin production structure and that between M and m incorporates the extent of world increasing returns. Ethier argues that as the two countries' production possibility curves become more similar - say because of a transfer from the capital-abundant country to the other - the volume of inter-industry trade will fall and the size of the manufacturing sector in the two countries will converge.

[6] Ethier (1979) points out that the only other author recognizing the role of the world market for firms engaged in international trade is Viner (1937).

Also, the volume of intra-industry trade in intermediate goods will increase both absolutely and relative to the volume of inter-industry trade. This is because a larger industry can support production of a wider variety of intermediate inputs at lower costs[7].

The literature based on external economies of scale has provided us with new insights into the causes of trade. Despite the indeterminacies which have emerged with respect to the pattern of trade, it has had the great merit of showing how "new" elements could be reconciled with more traditional hypothesis. In particular, increasing returns and factor proportion theory interact in the determination of the pattern of trade, given that countries will specialize in the industry intensive in that factor in which they are abundant. This implies the existence of two potential sources of gains from trade. As in the traditional Heckscher-Ohlin framework, countries benefit from specialization which enables them to take advantage of their differences. In addition to this, the existence of scale economies implies that trade with its impact on the scale of production, is a source of welfare gains because it allows for a reduction of the resources needed to produce the good.

Finally, note that models based on external economies of scale offer an explanation for the geographical conglomeration of industries and may therefore have a role in the emergence of the recent literature on economic geography[8].

---

7 A more explicit development of this model is proposed by Ethier (1982b) where finished manufactures are costlessly assembled from a bundle of all intermediate components. This model however, better fits into the monopolistic competition strand of the literature. We shall therefore discuss it later in the chapter.

8 Krugman (1991a) is a seminal contribution in this area.

4.5. IMPERFECT COMPETITION MODELS

The theory of industrial organization has played a crucial role in the recent evolution of international trade theory. Two main strands of the literature can be identified. One is fundamentally concerned with modelling the role of economies of scale in determining trade patterns. In this literature the main focus is not on the impact of increasing returns on market structure and the latter is dealt with as simply as possible. The second strand of the literature has imperfect competition at its core and one of its results is that increasing returns to scale are not necessary to generate trade between identical countries. In this section we shall concentrate on the second class of models and we shall review the monopolistic competition literature in Section 4.6.

4.5.1. Oligopoly models

Before discussing the oligopolistic models of trade, it is worth mentioning that monopoly has received an earlier attention in trade literature. A domestic monopoly facing a competitive world market has been introduced by Melvin and Warne (1973) in a general equilibrium *2x2* model and in a partial equilibrium setting by Fishelson and Hillman (1979). Their results are consistent with the wisdom emerging from traditional trade theory whereby free-trade has the welfare benefit of limiting domestic monopoly power. A significant body of literature - which we shall not consider here - has emerged which deals with the effects of different trade policy instruments on the degree of domestic monopoly power[9].

[9] Katrak (1977), Svedberg (1979), De Meza (1979), Jones (1987) and Jones and Takemori (1989) analyze trade policy issues when the

In the great majority, oligopolistic models have dealt with non-cooperative behaviour of firms characterized by monopoly power. Typically, these models assume a homogeneous good. Under Cournot competition the opening up of trade will generate potential trade flows: each firm will become part of a larger and more competitive environment. As a result, the perceived elasticity of demand will increase and the output decision will change, with larger quantities being produced. As industry output expands the price will fall. Note that this pro-competitive effect may even occur without any actual trade taking place, because it results from the mere **possibility** of trade which changes the slope of the demand curve. The appeal of these models lies in their ability to show how industrial structure *per se* can affect trade patterns. As stressed by Krugman "*the pro-competitive effect of trade is not exactly a scale economy story. It goes naturally with such a story, however, precisely because decreasing costs are the most natural explanations of imperfect competition*" (Krugman, 1990, p. 85). Indeed, despite its limitations, the Cournot approach has identified new explanations of international trade distinct from both comparative advantage and economies of scale.

Markusen (1981) distinguishes between the effects of monopoly power per se and those of monopoly power *cum* increasing returns within a two industry general equilibrium model where one of the sectors is - under free-trade - a duopoly. Assuming a Cournot-Nash behaviour, he shows that imperfect competition can *per se* generate

foreign producer is a monopoly. See Pomfret (1992) for a recent and excellent account of these models.

trade. Also, country size turns out to be a determinant of the pattern of trade with the large country importing the good produced in the oligopolistic sector. If the large country's output of this good falls sufficiently as a result of trade, the country experiences welfare losses. This result, however, is reversed by the introduction of increasing returns to scale. The large country will now have a cost advantage in the production of the monopolized good and this effect counteracts the country size effect.

A significant body of literature has shown how imperfectly competitive market structures can affect trade through market segmentation which generates the incentive to price discriminate. As a result, trade may arise simply because imperfectly competitive firms attempt to gain incremental sales by "dumping" products in export markets, *i.e.* selling them at less than the domestic price. Not only do these models explain trade occurring between identical countries, but they also predict the emergence of intra-industry trade in identical products. The seminal papers in this literature are the duopolistic models developed by Brander (1981) and Brander and Krugman (1983). Trade is sustained by the fact that each firm perceives its export demand elasticity to be higher than the domestic one and consequently will sell in the foreign market at a smaller mark-up. The volume of trade will be determined by the relationship between the difference in demand elasticity and transport cost, the latter embodying the firm's cost disadvantage in its export market. It follows that each firm will capture a larger part of its own domestic market than its rival. Note that - due to transport costs - the marginal cost of actually delivering a unit of output is higher for the export market than for the domestic one. Hence, an important implication of the analysis is that firms with different marginal costs can coexist in an imperfectly competitive market for a homogeneous product if firms with higher cost, perceiving a larger demand elasticity, charge a lower mark-up. Each firm will equate in both markets the perceived marginal revenue with marginal cost. This will give rise to a two-way trade. The equilibrium market shares are those which make exporters just willing to bear the burden of the transport cost. Benefits from trade will result if the increase in competition outweighs the waste associated with transport costs. If firms earn positive profits and transport costs are low, trade is welfare improving. The opposite will happen if transport costs are high.

Differences in the degree of seller concentration have also been shown to determine the pattern of trade. Helpman and Krugman (1985) demonstrate - in a two country model - that the less concentrated country will be characterized by a higher industry price index in autarky and will therefore import the good under free-trade. However, if there are other factors differentiating the two industries, patterns of trade may emerge which are not consistent with the relative costs of production. In other words, seller concentration has an independent effect on trade which may alter the effects of comparative costs. Furthermore, market concentration itself is affected by trade. In particular, the integrated market will be less concentrated than either of the two autarkic industries. This will result in an increase in competition which will be a source of welfare improvement. Hence, in imperfectly competitive markets, the effects of trade on competition *via* market structure will be an additional source of welfare gains.

The effects of different trade policy instruments on the oligopolistic market equilibrium are examined by Dixit (1984) within a two country model where each country's industry consists of an oligopoly where firms form Cournot conjectures.

Other models have relaxed the hypothesis of an exogenously given market structure and consider the case of free-entry. Brander and Krugman (1983) extend their analysis to the free-entry case and show that firms move down their average cost curve as trade opens up, thus generating a source of welfare gain. In general, if firms face no impediments in entering a market, free-entry may lead to the elimination of profits in the industry. Helpman and Krugman (1985) develop a model of contestable markets where firms behave *à la* Bertrand and entry and exit are costlessly unrestricted. Contrary to the case analyzed by Baumol, Panzar and Willig (1982), firms are assumed to produce only one good. The existence of economies of scale internal to the firm ensures that only one firm will produce the good and - due to market contestability - will price it at average cost. The implication of this for trade is that the good will be produced in the country which ensures the minimum price consistent with the zero-profit condition. Hence, the pattern of trade and the location of productions in the integrated market will be ultimately determined by comparative advantage factors. Building on Brander (1981), Brander and Spencer (1983) and Dixit (1984), Venables (1985) develops a Cournot oligopolistic model where market structure is determined endogenously *via* free-entry. After showing that intrà-industry trade in identical commodities will generally emerge, Venables analyses the effects of trade on welfare and confirms the welfare improving effects of trade found by Brander and Krugman (1983).

4.6. MONOPOLISTIC COMPETITION AND INTRA-INDUSTRY TRADE

Product differentiation has become a matter of concern to trade theorist since the publication of Chamberlin's (1933) and Robinson's (1933) works on monopolistic competition. In the preface of the English edition to his book, Haberler (1936) stresses the need to extend the theory of international trade to incorporate the message of the "*two outstanding books*" by Chamberlin and Robinson. Some not very successful attempts - see for instance Anderson (1936), Beach (1936) and Lovasy (1941) - were made to take these insights on board, but one had to wait until the late seventies before witnessing major progress in this area.

Product differentiation has long been regarded as a factor capable of explaining intra-industry trade. But horizontal product differentiation cannot - alone - offer a sufficient explanation for this phenomenon[10]. A limit to the number of varieties of a differentiated good can only exist if there are economies of scale in production. Clearly, because of this, product differentiation and increasing returns are hardly separable at a theoretical level. As stressed by Ethier (1979), however, until recently trade theorists could not deal with this link. A breakthrough was allowed by the two

[10] See Hesse (1974), Grubel and Lloyd (1975) and Caves (1981). Note that Falvey (1980) proposes a model where vertical product differentiation is based on factor content, the latter determining the pattern of intra-industry trade, consistent with constant returns to scale and perfect competition.

path breaking developments in the industrial organization literature discussed in Chapter 2. The first is the monopolistic competition model by Spence (1976) and Dixit and Stiglitz (1977). Dixit and Norman (1980) offer an early application to trade theory of the love for variety approach to product differentiation and discuss its implications for trade patterns and welfare. The second is the characteristic approach developed by Lancaster (1966, 1971, 1979).

One of the strong attractions of the monopolistic competition literature is its ability to provide answers to the issue of intra-industry trade in a very simple setting, where strategic interaction between firms are negligible and are in fact ruled out in models of non-localized competition. Free-entry leads to the elimination of equilibrium profits. Price, however, is above marginal cost, due to the monopoly power resulting from product differentiation.

The horizontal product differentiation literature on trade began with the seminal work of Krugman (1979a) and Lancaster (1979, 1980). In both these models all trade is intra-industry, given the assumed one-sector framework. On the demand side, preferences are described by utility functions which reward product diversity. On the supply side, there are increasing returns to scale internal to the firm, with each firm specializing in the production of one of the differentiated varieties of the good. The autarkic version of these models relies heavily on the industrial organization literature discussed in Chapter 2. Their setting leads to monopolistically competitive market structures in the differentiated product industries with equilibria characterized by a finite number of commodities.

Both these models are built within the Chamberlinian framework of non-localized competition. Krugman (1979a) uses the representative consumer framework based on the Dixit-Stiglitz utility function. Lancaster (1979) bases his analysis on the characteristic approach he himself developed. In both models firms engage in price competition. In Krugman the product space is not specified, while in Lancaster's model firms also compete on the choice of variety.

The crucial implication of these models for trade theory is that when different specifications of the good are produced in different countries, consumers' love for variety will ensure the emergence of intra-industry trade. Indeed, alternative formulations of preferences do not significantly affect the results in terms of trade patterns. The critical role of the preference structure is to provide brand-specific demand functions and hence to generate trade. The great theoretical appeal of these models lies in their ability to explain trade occurring between **identical** countries, even in the absence of market segmentation. This result stems from some - rather strong - assumptions. In what follows, given the focus of this work, we shall concentrate on Krugman's model.

4.6.1. Krugman's model

The essence of the autarkic structure of the model proposed by Krugman is identical to the Dixit-Stiglitz framework discussed in Chapter 2.

Assume that a horizontally differentiated commodity is produced in the economy with labour as the only factor of production. Let L be the given number of identical workers/consumers, each earning an income w. Hence, aggregate expenditure will be given by wL. Consumers have identical preferences described by a constant elasticity of substitution utility function which - as in equation *(3.1)* - is given by

$$U = \left(\sum_{i=1}^{N} d_i^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)} \tag{4.2}$$

where N is the number of varieties, d_i is the **individual**[11] consumer's consumption of variety i and $\sigma>1$ is the elasticity of substitution between varieties. As in Krugman (1980), we assume that σ is constant. Note that Krugman (1979a) uses a variable elasticity of substitution, with σ decreasing in d_i. A variable elasticity has different implications for the effects of trade on the overall number of varieties available for consumption. We shall return to this point later in the analysis. The above utility function will be maximized subject to the budget constraint

$$w = \sum_{i=1}^{N} P_i d_i \tag{4.3}$$

where P_i is the price of variety i. The demand function for a variety i will be given by

$$d_i = w\, P_i^{-\sigma} \left(\sum_{i=1}^{N} P_i^{1-\sigma} \right)^{-1} \tag{4.4}$$

If we define the price index P as in equation *(3.3)*, equation *(4.4)*

[11] In this example we follow Krugman's notation and let the representative consumer utility function represent individual preferences rather than those of the aggregate consumer sector.

becomes

$$d_i = \frac{w}{N} P_i^{-\sigma} P^{\sigma-1} \tag{4.5}$$

Given that all consumers are identical, the demand facing each firm producing a variety i will be given by

$$D_i = d_i L \tag{4.6}$$

The labour used in the production of each variety is a linear function of output, that is

$$l_i = \alpha + \gamma Q_i \tag{4.7}$$

where Q_i is the output of good i, l_i is the quantity of labour used to produce Q_i, $\alpha>0$ is a fixed amount of overhead labour and $\gamma>0$ is the reciprocal of the marginal product of labour. For a given nominal wage w, equation *(4.7)* yields the cost function $C_i=w\alpha+w\gamma Q_i$ which is clearly equivalent to equation *(3.9)* for $w\alpha=K$ and $w\gamma=\beta$. Hence, equation (4.7) implies decreasing average costs and constant marginal costs and will generate an incentive for each firms to specialize in the production of a single variety of the differentiated good.

As in the standard Dixit-Stiglitz model, firms are assumed to have identical costs and to behave non-cooperatively. Furthermore, the symmetry of the utility function rules out the existence of localized competition between firms. Assuming equilibrium to hold in the market for each variety, we have $D_i=Q_i$. Every producer will maximize profits by taking the price of the others as given and charge a price which equates marginal revenue to marginal cost. Given the homogeneous cost structure of the model, in equilibrium all varieties are sold at the same price and in the same quantity. Hence,

$$P_i = P = \sigma\ (\sigma-1)^{-1}\ w\gamma \qquad (4.8)$$

and $D_i=D$ for all i. Note that the pricing condition in *(4.8)* is as usual independent of output[12]. Under free-entry, all super-normal profits are eliminated and prices equal average costs.

The market clearing condition in the labour market, together with the symmetry of both quantities produced and production technologies, implies that $L=Nl_i$, where N is the number of firms in the industry. It follows, given equation *(4.7)* that the equilibrium number of firms will be given by

$$N = \frac{L}{\alpha + \gamma Ld} = \frac{L}{\alpha + \gamma D} \qquad (4.9)$$

Krugman assumes that the two countries are identical in every respect, *i.e.* they have the same size, preferences and technology. Their autarkic equilibria will therefore be identical. The wage rate will be the same and any two varieties i and j will be sold in the same quantity and at the same price regardless of where they are produced. The opening up of trade between the two countries has two main implications. On one hand, consumers in both countries will be able to choose amongst the overall number of varieties available in the free-trade market. On the other hand, producers will face a larger market and will be able to sell goods to both sets of consumers. Each individual in each of the economies will maximize the utility function

12 In Lancaster's model, the markup function depends on prices and the number of brands.

$$U = \left[\sum_{i=1}^{N} d_i^{(\sigma-1)/\sigma} + \sum_{i=N+1}^{N+N^*} d_i^{(\sigma-1)/\sigma} \right]^{\sigma/(\sigma-1)} \tag{4.10}$$

where $\sigma>1$ is identical in the two countries and N^* is the number of varieties produced in the foreign country. The free-trade demand curve facing each firm will be given by

$$D_i = d_i(L+L^*) = \frac{(wL+w^*L^*)}{N+N^*} P_i^{-\sigma} P_t^{\sigma-1} \tag{4.11}$$

where P_t is the free-trade price index given by

$$P_t = \left[\frac{1}{N+N^*} \left(\sum_{i=1}^{N} P_i^{1-\sigma} + \sum_{i=N+1}^{N+N^*} P_i^{1-\sigma} \right) \right]^{1/(1-\sigma)} \tag{4.12}$$

Trade will take place because, given the existence of increasing returns in production, each variety will be supplied by only one firm and only in one country. The direction of trade is not determined, in the sense that it is not possible to establish which varieties are produced in which country. This stems from the fact that the product space is not specified. The volume of trade, however, is determined[13]. Given the love for variety, all goods produced in the integrated market will be purchased. The number of goods/firms in each country will be determined, as in autarky, by the labour force operating in the country. Given that the output of each variety is now equal to

[13] Lancaster's version of the monopolistic competition model of trade shares the indeterminacy of the direction of trade. However, because product variety is somewhat structured in the model, Lancaster's approach allows to some extent to explore the implications of different patterns of specialization.

$d(L+L^*)$, the number of variety produced in each country will be given by

$$N = \frac{L}{\alpha + \gamma\ d\ (L+L^*)} \tag{4.13}$$

and

$$N^* = \frac{L^*}{\alpha + \gamma\ d\ (L+L^*)} \tag{4.14}$$

Note, however, that given that the two countries are assumed to be identical with $L=L^*$, the following will hold

$$N = N^* = \frac{L}{\alpha + \gamma D} = \frac{L^*}{\alpha + \gamma D} \tag{4.15}$$

that is the two countries will produce an identical number of varieties. Moreover, given that $L=L^*$, $w=w^*$ and $N=N^*$, the demand function in *(4.11)* will become

$$D_i = D_i^* = \frac{w2L}{2N} P_i^{-\sigma} P_t^{\sigma-1} = \frac{wL}{N} P_i^{-\sigma} P_t^{\sigma-1} \tag{4.16}$$

that is all varieties will be produced in the same quantity, regardless of their country of origin. Note that in this specification of the model - as clearly implied by equation *(4.16)* - the level of output produced by each firm is not affected by trade. We shall return to this briefly.

Clearly, if the two countries are perfectly symmetric with $L=L^*$ the share of imports in each country expenditure will be *1/2*. Clearly, this implies that the volume of trade is maximized when the trading partners are identical. This result is obviously important because it explains one of the stylized facts of real world trade, namely that the volume of trade is greater the more similar are countries. Hence, the prediction of Krugman's model is in sharp contrast to those stemming from the orthodox comparative advantage framework where trade flows are larger the more different the trading countries are.

4.6.2. Extensions

A number of authors - using both the Lancaster and the Dixit-Stiglitz frameworks - have addressed the issue of the coexisting in the real world of intra and inter-industry trade. Essentially, this has been done by fitting a monopolistically competitive setting in a standard factor endowment framework. Krugman (1981) has extended his basic model to a multi-sector one. Each economy produces two horizontally differentiated goods, with product substitutability being assumed to be higher within than across groups. Labour is the only factor of production even though it is not homogeneous but industry specific. Full factor mobility exists within an industry but not across industries and countries. The two countries are identical in every respect but for their relative endowments of the two types of labour. Both inter and intra-industry trade will emerge. The former will reflect differences in factor endowments. The latter will be driven by consumers' love for varieties and by the existence of economies of scale, which limit the number of varieties produced in one country. Hence, the industrial structure of a country's production is determined by factor endowments and each country will be a net exporter in those industries in which it has a comparative advantage. Given intra-industry specialization, however, each country will also engage in two-way trade, importing some varieties in industries in which it is a net exporter. Clearly, the proportion of total trade which is intra-industry in nature depends on the difference in factor endowments: the higher the degree of similarity in factor proportions the larger the share of intra-industry trade. This extremely simple model is consistent with the fact that the increasing significance of intra-industry trade has not been accompanied by the disappearance of inter-industry trade. These two types of international trade are here reconciled by marrying the Chamberlinian world to the standard Heckscher-Ohlin framework. Helpman (1981) proposes a two-sector model with preferences *à la* Lancaster. Contrary to Krugman (1981), however, Helpman assumes that only one industry is subject to increasing returns and produces a differentiated commodity, while the other exhibits constant returns to scale and produces a homogeneous commodity. Also, two factors of productions are used (capital and labour) which are fully mobile within each economy. The results of the model are similar to those obtained by Krugman. Inter-industry trade results from differences in factor endowments and intra-industry trade - whose volume is maximized when the two countries are of equal size - is generated by idiosyncratic preferences and increasing returns. Note that in this type of models if factor endowment differences are eliminated, all trade will be intra-industry. Hence, the more similar are the countries the larger will be the proportion of two-way trade[14].

The link between comparative advantage theories and increasing

[14] Lawrence and Spiller (1983) develop a model similar to Helpman's (1981) but where firms in the monopolistically competitive sector face significant fixed costs associated with entry.

returns *cum* product differentiation is also used to explain the patterns of trade between a technologically advanced physical and human capital abundant North and an unskilled labour abundant South. Models in this tradition include Markusen (1986) who constructs a model which combines monopolistic competition, differences in factor endowments and non homothetic demands which incorporates North-South differences in per-capita income. Due to the non-homotheticity assumption, different goods have different income elasticities of demand and differences in per-capita income become significant in explaining the pattern of trade. Hence, the labour abundant South turns out to be relatively specialized in the production and - due to its lower per-capita income - in the consumption of the labour intensive commodity which has a lower income elasticity of demand. Instead, the capital abundant North specializes in the production of the capital intensive differentiated commodity whose income elasticity of demand is higher. Grossman and Helpman (1989), within a dynamic framework, model the creation of comparative advantage through research and development and the evolution of world trade over time. In this literature there is a strong link between technology and product innovation, the latter often modelled within Chamberlinian monopolistically competitive frameworks. Krugman (1979b) and Dollar (1986) have models of the product cycle where the North is characterized by a continuous introduction of new models. In Feenstra and Judd (1982) firms in one country develop products and sell the knowledge of how to produce them to monopolistically competitive firms in another country. Technology transfer of this type is also analyzed by Grossman and Helpman (1991c). Findlay and

Kierzkowski (1983) develop a model of international trade in human capital[15]. Trade in technology had not be properly dealt with in the perfectly competitive literature, possibly because investment in knowledge can plausibly be modelled as a fixed cost which generates increasing returns internal to the firm. An extension to this literature has entailed the assumption that the technology transfer occurs within firms. Krugman (1980), Helpman (1984) and Helpman and Krugman (1985) have all analyzed the role of multinational corporations in trade and technology transfer. Wright (1993) develops a model where transfer of technology occurs in a framework characterized by information asymmetries concerning technologies and the cost of operating across national borders.

Another line of research has analyzed the effects of incorporating transport costs. In general the existence of transport costs poses significant tractability problems; as a result, they have frequently been assumed to be either insignificant or prohibitively high with a strict division emerging between tradeables and non-tradeables industries. An interesting result emerging from this literature is that if there are non-tradeable goods produced under conditions of increasing returns, there may be an incentive to migrate and concentrate industries in large countries[16]. Positive but not prohibitive transport costs are assumed in Krugman (1980) and in Venables (1987) who extends Krugman's model to allow for asymmetries

[15] Within a vertical product differentiation framework, these issues are also discussed by Flam and Helpman (1987).

[16] See, for instance, Helpman and Razin (1984). Helpman and Krugman (1985) suggest that there may be an incentive to relocate consumption rather than production. Clearly, this type of issues have contributed to the recent developments in economic geography.

in consumers' tastes. The analysis suggests that countries will tend to be net exporters of goods for which they have large relative domestic markets. Given the existence of transport costs, in the presence of increasing returns production will be located only in one place, typically in the larger market from which it will be exported.

The horizontal differentiation theory of intra-industry trade has not been limited to analyzing trade in final products. Ethier (1982b) suggests that scale based international trade is likely to be more important in intermediate than in final goods, and argues that the scope for product differentiation is greatest for specialized components and capital goods than for consumption goods. Manufacturing output is modeled as a constant elasticity of substitution function of the existing varieties of intermediate inputs. When the equilibrium is symmetric, all inputs are priced the same and output costs decline with the number of varieties of the intermediate good. Each variety is produced with increasing internal returns to scale and their number is an endogenously determined function of the scale of world manufacturing production. As a result, the output of the final good is subject to international economies of scale. Ethier shows - in a more formal way than in his previous paper (Ethier, 1979) - that intra-industry trade is complementary to international factor mobility to the extent that the latter reduces differences in endowments between countries (and with them the scope for inter-industry trade). An important feature of this model is that the international nature of economies of scale depends on the tradeability of the intermediate differentiated inputs. Models of trade of intermediate services are also proposed by Markusen (1988, 1989). Recently, Ishikawa (1992) analyses the case in which only the intermediate good is subject to increasing returns to scale.

Finally, the work in the imperfect competition literature has also offered new insights into the links between international trade and growth, following the breakthrough in the theory of endogenous growth. But because this extension goes beyond the scope of this study, we shall not review the underlying models here. A unified treatment of it is provided by Grossman and Helpman (1991d)[17].

4.7. IMPERFECT COMPETITION: THREATS TO FREE-TRADE

It is obvious that the developments in trade theory described above are rich of significant welfare and normative implications.

The changing character of trade and the subsequent failure of comparative advantage theories to satisfactorily explain it, has led to a reconsideration of traditionally accepted arguments about trade policy. In the orthodox vision - based on perfectly competitive markets - free-trade and strictly non-interventionist policies are the best stance to ensure the exploitation of comparative advantage. This view simply reflects the fact that perfect competition - in the absence of market distortions – ensures the most efficient allocations of resources, nationally and internationally. The recent theory has highlighted new dimensions to the problem, leading to the identification of circumstances in which trade barriers could increase national welfare and a case could be made for government intervention.

[17] Contributions included Grossman and Helpman (1990a,b, 1991a,c), Romer (1990), Young (1991), and Rivera-Batiz and Romer (1991a,b).

The main threats to the free-trade stance have come from the external economies of scale and from the so called **"strategic trade policy"** strands of the literature.

The first argument against the universal desirability of free-trade is based on the persistence of supernormal profits characterizing imperfectly competitive equilibria. These excess profits are due to monopoly power resulting from entry barriers, or - in a R&D intensive environment - from the application of patent laws. Since a country's welfare is enhanced by an increase in its firms' profits, a government has an incentive to increase the share of international profits held by the domestic firm(s) at the expense of the foreign competitor(s). This argument was formally developed in a series of articles by Brander and Spencer (1981, 1983, 1984, 1985). If there are oligopolistic profits, because - say - barriers to entry prevent them from being driven to zero at least temporarily, then trade patterns that may give domestic firms a greater share of this profit are, from a welfare point of view, superior to others. Brander and Spencer argue that government intervention may have a role in shifting international profits away from foreign competitors, despite the fact that this goal is clearly shared by firms themselves. In their basic model, Brander and Spencer examine a duopoly (one domestic and one foreign firm) competing on a third-country's market. As a result of this simplifying assumption, domestic welfare coincides with producer's profit, given that domestic consumption is nil. Assuming a Cournot behaviour, the Nash equilibrium will be determined by the intersection of the two firms' reaction functions. These will be downward sloping, given that the foreign firm's best response to an increase in output by the domestic firm is to reduce the quantity produced. It follows that, given that the home firm's profit increases as its competitor's output shrinks, the home country would have an incentive to commit itself to produce more than the quantity corresponding to the Nash equilibrium. This commitment, however, would not be credible given the information that each duopolist has about the other, that is given that each firm knows that the other has already made its **optimal** choice. Brander and Spencer point out that the government can make this commitment credible, for instance by introducing an export subsidy for its industry. The subsidy will shift the domestic reaction function outwards, that is the home firm will find it optimal to supply larger quantities at every level of foreign output than it would before the subsidy. At the new equilibrium the home industry will hold a larger share of the international pool of profits. Hence, the government policy has altered the subsequent nature of the game.

Eaton and Grossman (1986) extend this analysis to consider a wider range of oligopolistic interactions and argue that the particular policy recommendation put forward by Brander and Spencer is model-specific and is not of general validity. For example, if the Cournot assumption is replaced with a Bertrand behaviour the optimal government policy is not an export subsidy, but an export tax. Hence, the effects of government intervention on the home country's profit share depends crucially on the behaviour of oligopolistic firms. Dixit (1984) extends the analysis to an oligopoly with more than one firm and also examines the effects of relaxing the assumption of zero domestic consumption.

Dixit and Grossman (1986) point at another weakness in the Brander and Spencer contribution, namely its reliance on partial equilibrium. This assumption implies that the subsidized industry can expand by drawing resources from other sectors in the economy. As a result, interventionist policies may promote a particular sector at the expenses of others. Targeting the sector of strategic importance and predicting the general equilibrium effects of such a move may prove difficult goals given that the amount of information required to undertake such a policy may not be available.

Venables (1985), in an oligopolistic model with endogenous market structure, shows that an interventionist policy may be desirable even when the profit shifting motive is absent because all supernormal profits are eliminated by entry. By increasing the profits of domestic firms, an export subsidy induces entry in the home industry. The resulting increase in competition reduces the domestic price and hence increases consumer welfare. In other words, the desirability of government intervention rests on its effects on the wedge between price and marginal cost. Note that in Venables (1985) firms can price discriminate between domestic and foreign markets. Horstman and Markusen (1986) relax this assumption and obtain a somewhat opposite result and show that free-entry restores the argument against an export subsidy. Trade liberalization allows firms to expand output and to move downward along their average cost curve. Dixit and Kyle (1985) study the use of trade policy in promoting and deterring entry and analyze the possibility of reactions of foreign governments.

The message which emerges from these models is that the desirability of policy intervention depends on industry structure, on the strategic behaviour of firms in the industry and on whether markets are segmented or not. Markusen and Venables (1988) attempt to provide a unifying framework within which to reconcile the apparently conflicting results stemming from this literature and to highlight the role played by the different assumptions in determining them[18].

Krugman (1984) provides another theoretical justification for government intervention. In this paper, he points out that protection of the domestic market can serve as export promotion. The model is a modification of Brander and Krugman (1983), where firms marginal costs are assumed to be decreasing in output rather than being constant. The effect of protection will then be to allow the domestic firm's output to expand at the expense of the foreign firm's output. The ensuing reduction in marginal cost will make the domestic firm more competitive and its sales will grow in the unprotected foreign market. In the same paper, Krugman examines the case of dynamic economies of scale arising from R&D and from a learning curve. In both cases the nature of the argument is unchanged.

Clearly, despite their model specific features, the results which emerge from the new industrial organization literature cast doubt on the validity of the normative prescriptions of orthodox trade theories. These arguments, however, have not been sufficient to completely undermine the faith in free-trade. And this has not been merely because of the criticisms addressed to them by some of the contributions mentioned above. In fact the imperfect competition

---

[18] For a critical appraisal of the strategic trade policy literature see Grossman (1986).

literature has itself lent further support to free-trade policies.

4.8. IMPERFECT COMPETITION: NEW ARGUMENTS FOR FREE-TRADE

The allowance for economies of scale, product differentiation and strategic behaviour amongst competitors has led to new arguments in favour of trade liberation.

4.8.1. Product variety and welfare gains

The threats to free trade discussed above have mainly come from oligopolistic models. The emergence of the monopolistically competitive theories did not pose a comparable challenge to the proposition that trade is welfare improving. On one hand, the elimination of long-run profit by entry hinders the profit shifting argument for protection. On the other hand, the two main features of this model - product differentiation and internal increasing returns - add strength to the arguments for free-trade. The latter, while increasing the degree of product variety available to consumers, allows for specialization in the production of different goods and leads to the achievement of increased scale of production.

International trade allows consumers to operate in the world market for each variety and thus enables them to buy goods which are not produced domestically. In other words, trade brings about welfare gains in the form of an increase in the number of varieties.

Recall that in the version of Krugman's model discussed in the previous section, the free-trade number of varieties amongst which consumers can choose (N_t) is given by

$$N_t = N + N^* = \frac{L + L^*}{\alpha + \gamma\, d\, (L+L^*)} = \frac{L + L^*}{\alpha + \gamma\, D} \qquad (4.17)$$

which corresponds to the number of goods which would be produced by a single economy whose labour force was equal to $(L+L^*)$. N_t is **always** larger than the number of varieties produced in autarky by any of the two countries.

The effects of trade on the number of varieties produced in each country will be different depending on the nature of the elasticity of substitution between varieties. In general, assuming a representative consumer utility function of the form $U=\sum_{i=1}^{N} u(D_i)$, the own price elasticity of demand for each variety can be approximated by $\sigma=u'(D_i)/D_i u''(D_i)$, assuming that the marginal utility of income is not affected by changes in individual prices[19]. In this case, σ is a decreasing function of D_i, in other words, as more varieties become available - and consumption for each individual variety falls - the demand curve for each product becomes more elastic. Or put differently, as the number of varieties increases the different goods will become better substitute for one another. Clearly, in the case we have analyzed above - where the sub-utility is of the form $u(D_i)=D_i^{\sigma-1/\sigma}$ - the elasticity of demand is constant. As is evident from equation *(4.17)*, the number of firms operating in each country does not change as a result of free-trade. It follows that $N_t=N+N^*$.

---

[19] From the definition of price elasticity of demand, $\sigma=\frac{dD_i}{dP_i}\frac{P_i}{D_i}$. From the first order conditions of utility maximization, $P_i=u'(D_i)/\lambda$, where λ is the Lagrangian multiplier and the marginal utility of income. Hence, $P_i/D_i=u'(D_i)/\lambda D_i$ and $dD_i/dP_i=\lambda/u''D_i$ from which $\sigma=u'(D_i)/u''(D_i)D_i$.

Hence, with a constant elasticity of substitution, the opening up of trade between two identical economies doubles the number of varieties available to consumers. When the elasticity is variable, as trade increases the degree of product variety, consumption of each commodity will fall and the elasticity of demand σ will increase. In this event, consumers' choice will expand but less than double. In both cases, but to different degrees, consumers will be made better off by trade, given the widening of the product range.

Note that this positive welfare effects of trade does not imply - given the second best situation - that protection will necessarily be welfare reducing. Clearly, when price is above marginal cost, trade barriers may still increase national welfare if they shift consumption from imported to domestically produced varieties. These potential gains will have to be weighed against any reduction in the number of varieties available. In the constant elasticity of substitution case, for instance, a tariff will not affect the price elasticity of demand and hence will not increase the degree of firms' monopoly power. Hence the number of available varieties will not be affected. Its only effect will be to shift consumption from foreign to domestic sources: existing varieties will be consumed in larger quantities in the domestic market and in smaller quantities in the export one. However, protection would be costly even in this case if the tariff was at a prohibitive level, entailing the complete elimination of trade[20].

In analyzing the welfare effects of importing commodities which

[20] These issues are discussed in Gros (1987). The effects of a tariff in a monopolistically competitive setting have also been analyzed by Flam and Helpman (1987) and by Helpman (1990).

compete directly with a domestic monopolistically competitive industry, Venables (1987) relaxes the assumption that imported and domestic varieties enter the utility function symmetrically, but retains symmetry within each group. As a result, the price elasticity of demand differs between foreign and domestic varieties. In these circumstances, trade may lower welfare if it results in foreign varieties with a larger elasticity of demand displacing domestic varieties with a lower elasticity. Trade restrictions may then be welfare improving because they may result in the provision of varieties which - due to their lower elasticity of demand - are more socially desirable.

Lancaster (1984) shows that the degree of product differentiation in the home industry and the number of varieties available to home consumers are both affected by the existence and level of intra-industry trade and by protection. Tariff protection may increase product variety because of the imperfect substitutability between home and imported goods. A tariff reduces the competitiveness of imports and this will shift demand towards home products. The resulting increase in the monopoly power of domestic firms raises their profits. This, by attracting new entry, will result in an increase of the number of domestically produced goods. Lancaster (1991) shows that if there is product diversity and increasing returns to scale, a non-prohibitive tariff may increase the welfare of a small open economy by correcting the sub-optimal degree of product variety, the latter arising from market failure due to economies of scale.

4.8.2. The rationalizing effects of free-trade

At the core of the earlier arguments in favour of trade liberalization is the concept of allocative efficiency. Trade is beneficial because it allows for resources to be allocated in areas where a country has a comparative advantage. Under imperfect competition it is possible to identify other sources of efficiency gains. These are commonly referred to as the **rationalizing effects of trade.**

Two are the main dimensions of trade induced rationalization. First, by increasing competitive pressure trade liberalization curbs excess market power and hence results in reduced price-cost margins. Second, in the presence of increasing returns, trade will result - given the increase in the extent of the market - in larger production scales and in lower average costs.

Within an oligopolistic framework[21], the rationalizing effects of trade liberalization is discussed in Markusen (1981) who argues that decreasing cost firms confronted by foreign competition and allowed - by trade liberalization - to take advantage of an increase in the extent of the market will either increase in size or disappear. Dixit and Norman (1980), within a two sector general equilibrium model, show that the move to free-trade expands the size of the market and is equivalent to an increase in the number of consumers. Although economies of scale lead to oligopolistic markets even in the absence of barriers to entry, the number of firms which can produce profitably in an industry will be larger the larger is the size of

---

[21] The monopoly power reducing effects of trade have also been highlighted within models set in more standard frameworks. See for instance, Bhagwati (1965, 1978) and Krueger (1978).

the market and, in turn, the smaller will be the monopoly power exercised by any one firm. Assuming perfect symmetry in costs, Dixit and Norman show that as the number of consumers increases the fixed cost per capita falls, profits rise and entry into the industry is encouraged. In the reciprocal dumping model by Brander (1981) and Brander and Krugman (1983), the opening up of trade increases competition and leads to a lower price by reducing the monopoly distortions. This pro-competitive effect may or may not prevail over the welfare waste associated to transport costs, the final outcome depending on the size of the latter. As a result, the sign of the net welfare effect is not certain[22]. Fung (1992) casts doubt on the general validity of the pro-competitive argument. He analyses a domestic duopoly where firms interact repeatedly and argues that a tariff reduction may or may not increase competition - and thus discourage collusive behaviour - depending on industry characteristics and on the size of tariff reduction. Hence, he concludes that free-trade cannot be generally seen as a substitute for antitrust policy.

The rationalizing effects of trade are also discussed in the monopolistic competition literature. Note, however, that this source of welfare gains is not operational in the constant elasticity of substitution model *à la* Krugman where neither firm scale nor price-cost margins are affected by market integration. Instead, the pro-competitive effect of trade takes place in the variable elasticity of substitution case. When the elasticity is variable, as trade

---

[22] See also Helpman and Krugman (1985), Yano (1989), Krishna (1989) and Eldor and Levin (1990) for analyses of the effects of trade liberalization in the presence of quantitative restrictions.

increases the number of available varieties, consumption of each will fall and the elasticity of demand σ will increase. This, however, will reduce the price mark-up and the profitability of each firm. As a result, a smaller number of firms will survive after trade in each country and the scale of production of each variety will increase. In this event trade has both welfare effects: it increases the degree of product varieties and reduces average costs and equilibrium prices by increasing the scale of production of each firm.

Note that in Lancaster's version of the monopolistic competition model, the distance between goods decreases as the number of varieties increases. Hence, the proliferation of varieties resulting from trade always affects the elasticity of substitution between products, even though they are not all equally good substitute for each other. As a result, the opening up of trade, with the ensuing increase in the number of varieties, rises each firm's price elasticity and reduces its monopoly power. Within each country, there will be a smaller number of firms each producing a larger quantity and selling at a lower price than in autarky. Consumers will gain from both the increased production efficiency and the larger number of available varieties which reduces the distance between ideal and existing product specifications.

Trade liberalization, by increasing competition, has also been seen as reducing internal slack in firms. As argued by Horn, Lang and Lundgren (1995), however, this view has received more attention in policy discussions than in theoretical trade literature. In a model where ownership is separated from control, these authors demonstrate that the exposure to international trade, by increasing competition, may induce an increase in supply of marginal cost reducing managerial effort. This will lead to an increase in the joint surplus of both the owner and the manager.

Thus, in general, the literature which stresses the effects of trade on market structure and performance has lent support to the so called import discipline hypothesis which suggests that the threat of entry by foreign competitors will induce domestic firms to contain their price-cost margins[23]. Indeed, the role of imports in limiting monopoly power has been one of the arguments more often used to support trade liberalization policies. The vulnerability to foreign competition of U.S. manufacturing industries traditionally dominated by American firms (computers, automobiles, consumer electronics, etc.) during the last two decades was ascribed by many to the insulation from serious foreign competition which domestic firms had enjoyed for too long. This argument has motivated a significant body of empirical literature which provides - even at the firm level - evidence of the positive relationship between trade liberalization and efficiency. De Melo and Urata (1986) compare price-cost margins for Chile for two years before and after trade liberalization (1967 and 1979) and obtain findings supporting the import-discipline hypothesis. Domowitz, Hubbard and Petersen (1986) use time series cross section data on U.S. manufacturing between 1958 and 1981 and find import competition to reduce margins particularly in highly concentrated industries. Although to a smaller extent, this result was confirmed for concentrated industries by De Rosa and Goldstein (1981) who analyzed price changes in manufacturing industries during

[23] See Jaquemin (1982).

the period 1973-1976. At the industry level, MacDonald (1994) uses a panel of 94 manufacturing industries over four three year periods to analyze the effects of import competition on productivity growth. He finds evidence that growing international rivalry by imposing competitive pressure on firms which were previously isolated generates efficiency gains.

The presumed rationalizing effects of trade have also been considered at length in the context of the debate surrounding European integration. In addition to the standard gains based on the exploitation of competitive advantage, trade liberalization is supposed to bring about efficiency gains as a result of increased competition. From a theoretical perspective, the elimination of barriers to trade following the implementation of the Single European Market has been thought to lead to a more competitive environment by virtue of the ensuing increase of the number of competitors, and the reduction of the market power of domestic firms. The increase in competition, in turn, is expected to generate an increase in output. This effect, in the presence of economies of scale will lead to a static welfare gain as the margin is reduced between price and marginal cost. Furthermore, the expansion of output may entail gains from economies of scale also in conjunction with the saving in fixed cost if a smaller number of larger firms survive in the industry as a result of trade liberalization, given the resulting fall in average costs.

Smith and Venables (1988) carry out a numerical assessment of the welfare effects of trade liberalization in the European Community based on an imperfectly competitive model with increasing returns to scale. They analyse two distinct cases, one consisting of gradual reduction of trade costs and one where firms consider themselves as part of wider integrated market. The welfare gains are very small in the first case and larger in the second. Other authors have attempted to quantify the likely welfare effects of the elimination of trade barriers in the European Union. See for instance, Norman (1989, 1991), Venables (1990), Gasiorek, Smith and Venables (1991) and Smith (1989)[24]. Grinols (1993) estimates the magnitude of the welfare effects generated by a move towards greater integration with focus on the role played by increasing returns. A shift from a customs union to a common market is shown to bring about some if not large gains when industries characterized by increasing returns are enlarged by trade liberalization. It is interesting to stress that in most cases these studies seem to suggest that the gains from the Single European Market are not very significant. This is clearly at odds with the expectations generated by the theoretical literature[25].

An important feature of the studies mentioned above is that they concentrate on the static effects of integration. A substantial amount of literature has recently stressed the dynamic productivity and growth consequences of trade liberalization. As argued by

[24] Cox and Harris (1985), Wonnacott (1987) and Schott (1988) assess the welfare implications of trade liberalization between the United States and Canada and highlight the existence of potential gains from increased product varieties and/or the exploitation of economies of scale.

[25] Note, however, that the majority of these works consist of calibrated models and their results are strongly dependent on the underlying specific assumptions. Levinsohn (1993) uses econometric estimates to test the "import-as-market-discipline" hypothesis for five Turkish industries. In all five, the hypothesis was supported.

Grossman and Helpman (1990), not only do trade policies have a once and for all effect on growth but they also affect its long-run rates. In particular, trade liberalization may permanently increase growth by accelerating the rate of technological change. This effect would result from the rise in the returns to innovation generated by the expansion of the extent of the market as well as from the more advanced technology embodied in intermediate imported inputs. Note, however, that the results of this literature do not uncontroversially oppose protection. If a country does not have a comparative advantage in R&D activities, free-trade may may encourage a pattern of international specialization which induces a shift of resources away from research sectors. In such cases, protection may foster growth by opposing the tendency towards the shrinking of research intensive sectors. Rivera-Batiz and Xie (1993) consider the impact of integration on long-run growth and show that trade liberalization can bring about net welfare gains through an increase in the rate of growth even when it does not raise the short-run level of production. In this particular paper, contrary to Rivera-Batiz and Romer (1991), integration is assumed to take place between asymmetric countries. While in the symmetric case integration is beneficial to the growth rates of both countries, when the two economies are characterized by asymmetries in either factor endowments or preference structures, welfare gains may not be general. In other words integration could generate uneven development by lowering the rate of growth of some countries[26].

Krugman and Venables (1990) address the issue of the possible

---

[26] See also Feenstra (1990) and Rivera-Batiz and Xie (1992).

effects of market integration and geographical asymmetries. Their findings suggest that integration may foster industry concentration given the incentive to conglomerate stemming from the reduction of trade costs. As a result manufacturing production in peripheral regions may decline, and this may offset the standard gains from integration of imperfectly competitive industries[27].

It is argued that the increase in competition following market integration may result in only the more efficient firms surviving while less efficient one are forced out, thus leading to a more concentrated industry. The competitive selection effect of market integration have been tested by Sleuwaegen and Yamawaki (1988) for several European countries. These authors find that seller concentration in national markets generally increase as a result of trade liberalization[28].

On the whole, the majority of the theoretical studies in this area seems to suggest that trade liberalization has rationalizing effects on industries. Attempts to quantify these, however, have failed to support them convincingly.

4.9. SOME CONCLUSIONS AND NEW DIRECTIONS FOR RESEARCH

The literature discussed so far is extremely vast and has explored a great number of lines of research. There are, however, some aspects of the current state of the art which are cause of

---

[27] These issues are further explored in Krugman (1991) and in Krugman and Venables (1995).

[28] Concentration of the integrated market is also shown to be increasingly important in determining the price-cost margin within national industries.

concerns.

With respect to the pattern of trade, as argued in Chapter 1, the degree of intra-industry trade penetration between similar countries is not symmetric as a great deal of the literature seems to suggest. This symmetry is a direct consequence of the assumptions underlying the standard models. More precisely, symmetry in the pattern of trade results from assumptions of homogeneity.

In general, in models of horizontal product differentiation differences across countries, albeit not denied, have a secondary role in the explanation of trade patterns. The emphasis is on the *similarity* of demand structures and production technologies. This is particularly true for models of international trade built within the monopolistically competitive framework, where these similarities are pushed to the limit by assuming fully identical economies. Imperfect competition and product differentiation, however, while explaining intra-industry trade, are not sufficient *per se* to capture the different degrees of reciprocal trade penetration which show the extent to which specialization still exists amongst industrial economies. As illustrated by Porter (1990) production and export of certain categories of goods, while not totally concentrated in one country, are dominated by it.

Note that by expressing concern about this assumption one does not intend to diminish the innovativeness of those international trade models which, based on the symmetry of countries, managed to explain how international trade could take place even between **identical countries**. This was clearly a major result, in a theoretical framework where trade could previoulsy only be justified on the basis of country differences. However, it is obvious that the assumed symmetry in technologies and demand leads to the predictable outcome that the free-trade market is symmetrically shared between the trading partners.

Different degrees of intra-industry trade penetration have indeed been obtained in the literature. For instance Krugman (1980) by introducing transport costs derives an equilibrium in which firms hold different shares in their domestic and foreign markets. Venables (1987) also obtains a similar result by allowing for both the presence of transport costs and asymmetric preferences where products from different countries have different weights in consumers' utility functions. In Krugman (1981) different market shares in the differentiated good markets stem, within a two-sector-two-factor model, from the existence of differences in factor endowments between countries[29].

These asymmetric trade patterns, however, do not stem from differences between the two countries' horizontally differentiated sectors. In other words, asymmetric shares of intra-industry-trade result from factors which are exogenous to the horizontally differentiated industry itself. The thesis put forward here is that asymmetric market shares may reflect, and hence ought to be explained in terms of, differences in the relative strength of countries **within** the industry.

The asymmetry generating factor we have in mind is technology. Of course, technology is only one of the possible ways of removing the symmetry hypothesis. The other most obvious one would be to

[29] These issues are also discussed in Helpman and Krugman (1985).

assume heterogeneity of firms' demand functions. This is done, for example, in Pascoa (1993) in a closed economy framework of monopolistic competition. Instead, in Venables (1994), within a model with identical technologies and demand functions, heterogeneity takes the form of only a subset of the firms' population finding it profitable to export, due to the existence of a fixed export cost.

The focus on technology is motivated by the observation that real world industries are indeed characterized by heterogeneity amongst competing firms both at the national and international levels. Even when employing the same broadly defined technology to produce similar products, firms do apply different types of knowledge which are embodied in people and organizations in historically determined ways which imply that technology is both a **firm-specific** and a **country-specific** product of past experience. At the national level, firms in an industry can be seen as being spread along a ray reflecting different levels of technical efficiency and market performance. At the international level, the same technological factors generate persistent country-specific domains in some productions, as reflected by the patterns of international specialization (see Dosi, Pavitt and Soete, 1990).

Also, note that the symmetry hypothesis is not neutral with respect to the gains from trade[30]. Models of monopolistic competition generally support the view that trade benefits symmetrically all partner countries. On one hand, the increased competition leads to a rationalization of the industry and generates efficiency gains. On

[30] In a different context, this is evident in the work by Rivera-Batiz and Xie (1993).

the other hand, in an environment characterized by a taste for variety, trade increases consumer welfare via an increase in the number of goods available for consumption.

Hence, in the remaining of this work we propose to analyze the role of technological asymmetries amongst firms and countries as a determinant of different intra-industry trade performances. We shall also investigate the way in which the introduction of such asymmetries affects the assessment of the welfare implications of trade.

In order to take account of the fact that in any given industry and country marginal cost will probably vary considerably due to differences in vintages of physical capital, labour productivity and organizational efficiency we shall build on the model developed in Chapter 3 which assumes firm-specific costs. In Chapter 5, we shall introduce another country into the picture. In order to reflect the fact that efficiency differences are also bound to exist between countries reflecting historical, political, and institutional diversity, the two countries's states of technology will be characterized by an efficiency gap. The analysis of trade within this new framework will be carried out in Chapter 6.

Chapter 5

INTER-FIRM AND INTER-COUNTRY EFFICIENCY GAPS: A PRE-TRADE ANALYSIS OF MARKET STRUCTURE

> *"...the general existence of* **asymmetries** *between firms and between countries in technological capabilities, technical coefficients and product performance...stems from the very nature of technology."*
>
> **Dosi, Pavitt and Soete, 1990**

5.1. INTRODUCTION

This chapter can be seen as a transitory chapter, in that it bridges the analysis and the results of the model of monopolistic competition developed in Chapter 3 and the international trade model which will be analyzed in Chapter 6. The analysis of the implications for market structure of the existence of firm-specific costs is extended to an inter-industry, inter-country comparison. The result is a comparative statics analysis of the autarkic situations preliminary to the opening up of free-trade between two countries characterized by similar but not identical technologies. Hence, in this sense, this chapter represents a step towards the full appreciation of the effects of trade on market structure and welfare.

More precisely, we compare two industries characterized by a monopolistically competitive market structure and producing horizontally differentiated goods. As in the model of monopolistic competition discussed in Chapter 3, both industries are characterized by firm-specific technology. We shall assume, however, that the two countries' states of technology are such that a gap exists between the average level of efficiency of the two industries. Both the efficiency gaps amongst firms and between countries are fixed, as if reflecting an element of historical accident which shapes future performances. As before, market structure is determined endogenously and the hypothesis of firms' heterogeneity together with the uncertainty about the level of efficiency potential entrants will obtain, imply that entry does not bring about the elimination of long run profit margins. Also, asymmetry in quantities, prices and profits is obtained both amongst firms and between countries, with the steady-state being characterized by a spectrum of firms' efficiencies, profit rates and market shares.

5.2. THE MODEL

In this section the partial equilibrium model of monopolistic competition developed in Chapter 3 is adapted to outline the features of two monopolistically competitive industries characterized by different levels of efficiency. The two industries belong to and operate in two different countries, without any trade taking place between them. The subscripts h and f are used to indicate the variables related to the two countries and are meant to signify **home** and **foreign** respectively.

In a sense, the two industries are subsets of the same, more broadly defined, industry. What enables us to distinguish between them is the geographical element - their being located in two different countries - together with the lack of any flow of goods and/or factors of production between them. The economic framework in which firms belonging to the industries operate is assumed to be **very similar**, but not identical. As stressed in Chapter 4, the trade literature generally over simplifies situations of similarity by treating them as if the countries involved were indeed identical. This simplification, however, is of considerable importance given the fact that even countries characterized by similar economic structure and degrees of industrialization show significant technological differences. Despite the high degrees of knowledge spill-overs characterizing an increasingly integrated world economy, technology remains to a great extent country-specific, because it stems from past experience and is shaped by the cultural and institutional environment which is, itself, the product of history.

It is not amongst the aims of this work to provide an analysis of the features of technology. Hence, the source of technological differences between countries will not be one of our concerns, and we shall only limit ourselves to acknowledging that these differences exist. In our model, two countries characterized by a very similar level of economic development and by a relatively similar type of industrial structure show technical differences which we assume to be the product of a **historical accident**.

The partial equilibrium framework within which the monopolistic competition model was constructed in Chapter 3 will be retained. Therefore, the economic environment in which firms operate will not be fully specified. Instead, the following hypotheses are meant to capture its main features:

(1) The two countries will be characterized by **identical consumer**

sectors. Hence, no difference whatsoever is assumed to exist between the two countries in either consumer tastes or incomes.

(2) Firms in the two countries will produce different varieties of the same horizontally differentiated good.

(3) Firms in the two countries will produce the good according to the same broadly defined technology. Hence, in both countries decreasing average costs will generate an incentive to specialize in the production of a single variety of the differentiated good.

(4) The state of technology, however, will only be similar, but not identical and an efficiency gap at the industry level will exist between the two countries.

A comment may be worth at this point with respect to the coexistence in the model of different industry efficiencies with consumers endowed with the same income. In fact, it would be plausible to expect lower income in countries characterized by lower efficiency. However, we are here operating within a partial equilibrium framework and efficiency gaps are at the level of an **individual industry**. The situation we are dealing with could be thought of as one in which a relative advantage of one country in one industry is compensated in some other sector by a relative disadvantage so that, at the **aggregate** level, the overall product (and hence income available to consumers) are the same. This point deserves more attention and has been left unnoticed in the literature. Behind the strong similarity between countries, reflected by - say - virtually identical per-capita incomes, which is used to justify the assumption of identicality, lie differences in particular sectors of the economy.

These are the source of differences in industrial structure and determine directly, and *via* their industrial structure effects, pattern of international trade specialization which cannot be predicted by models which disregard these differences.

5.2.1. The demand side

Consumers in the two countries are assumed to have identical tastes. The representative consumer's preferences are characterized by the Dixit-Stiglitz (1977) utility function, given by equation *(3.1)*. The problem of the representative consumer in each country j $(j=h,\ f)$ will then be

$$MAX. \qquad U_j = \left(\sum_{i=1}^{N_j} D_{ji}^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)}$$

$$s.t. \qquad P_j\ D_j = \sum_{i=1}^{N_j} P_{ji} D_{ji} \tag{5.1}$$

where $\sigma>1$ is, as before, the elasticity of substitution between varieties, which is assumed to be the same in both countries. D_{ji} and P_{ji} are consumption and price of variety i in country j. N_j and D_j are the number of existing varieties and the total consumption of the differentiated good in country j, and the price index P_j is defined as follows

$$P_j = \left(\frac{1}{N_j} \sum_{i=1}^{N_j} P_{ji}^{1-\sigma} \right)^{1/(1-\sigma)} \tag{5.2}$$

As in Chapter 3, it is assumed that $D_j=A_jP_j^{-\eta}$, where A_j is a positive constant reflecting a scaled measure of nominal income in country j and $\eta<\sigma$ is the price elasticity of demand. Also, in order to conform to the hypothesis of identical demand sides between the two countries, we need $A_j=A$ for all j, *i.e.* (other things equal) the nominal income spent on this good is identical in the two countries.

The solution to the above maximization problem yields the following demand function for variety i in country j:

$$D_{ji} = \frac{A}{N_j} P_j^{\sigma-\eta} P_{ji}^{-\sigma} \tag{5.3}$$

5.2.2. Technological differences between countries

Technology is regarded as the only source of difference between countries and amongst firms within each country. The technical heterogeneity amongst firms within each country takes the form of randomly generated firm-specific marginal costs. The efficiency gap between countries is modelled as an exogenously given difference in the mean of their marginal cost distributions.

The total cost function of a representative firm i in country j is given by

$$C_{ji} = \beta_{ji} Q_{ji} + K \tag{5.4}$$

where β_{ji} is the marginal cost, Q_{ji} is the level of output and K is the fixed production cost. The falling average costs will generate an incentive to specialization and in each country a one-to-one correspondence between the number of varieties available for consumption and the number of firms in the market will emerge. Firms in the two countries have production costs of the same functional form. Furthermore, not only do we assume that the fixed cost is identical amongst firms, but also that there are no differences in this respect between countries. The role of these last two assumptions is to ensure that the two countries are indeed **similar**, not only in their demand side, but also in their production side where they are characterized by the same broadly defined technology. However, contrary to the standard literature, the similarity is here preserved by allowing for differences in efficiency.

Within each economy, the state of technology is characterized as follows. Each firm is paired with a value of the marginal cost (β_j) randomly selected from a continuous uniform distribution, with larger values of β_{ji} signifying lower efficiencies. The efficiency gap between the two countries' state of technology is modelled as a difference in the mean of their marginal cost distribution. Hence, in the home country the β_h distribution is assumed to be defined over the interval $[1-\delta,\ 1+\delta]$, with $0<\delta<1$. Note that this is the same distribution assumed in Chapter 3. Instead, in the foreign country, β_f will be distributed over the interval $[1+\phi-\delta,\ 1+\phi+\delta]$ where $0<\phi<1$ represents the efficiency gap between the two industries. It follows that $E(\beta_h)=1$ and $E(\beta_f)=1+\phi$. Clearly, the mean efficiency is higher in the home country than in the foreign one. The parameter δ which defines the width of the distribution is assumed to be identical in the two cases.

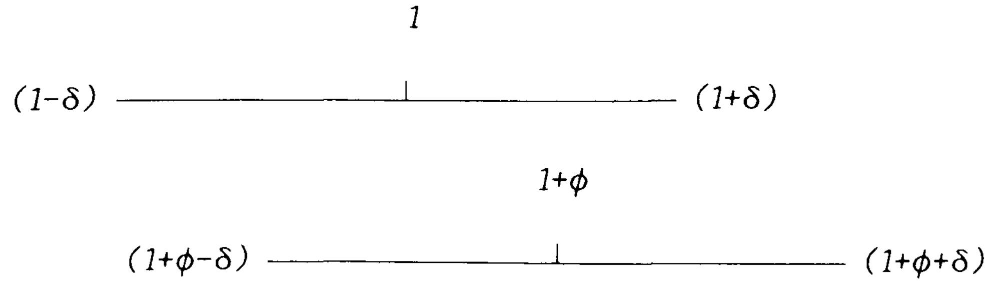

Figure 5.1.

The two distributions - which are illustrated in Figure 5.1 above - overlap within the interval $[1+\phi-\delta,\ 1+\delta]$. Thus, at each point within this region firms in the two countries have the same level of efficiency. However, firms whose β_{hi} lies between $(1-\delta)$ and $(1+\phi-\delta)$ are specific of country h and are more efficient than any other firm in country f. The opposite holds for those firms in country f whose β_{fi} lies between $(1+\delta)$ and $(1+\phi+\delta)$, which only exist in that country and are less efficient than the least efficient firms in country h.

As in Chapter 3, given the state of technology characterized by cost heterogeneity, the competitive selection process within the two countries will result in the endogenous determination of the steady-state efficiency distribution of firms.

5.3. DETERMINATION OF THE AUTARKIC STEADY-STATES

In each country, entry and exit of firms into the industry will determine the endogenous market structure. As we have ruled out any movement of goods and factors of production between industries, entry is a country specific phenomenon. The hypotheses at the basis of the entry and exit process are the same as those we discussed in Chapter 3 which we briefly summarize here.

Static expectations about the future structure of the domestic market are assumed to characterize the behaviour of incumbents, who take the number of firms operating in the industry as given. Given the cost function in *(5.5)* and assuming that $Q_{ji}=D_{ji}$, the profits of a firm i in country j are given by

$$\Pi_{ji} = P_{ji}D_{ji} - \beta_{ji}D_{ji} - K \qquad (5.5)$$

Thus, for any given N_j, the first order condition for profit maximization gives the usual optimal price rule for a firm i in country j

$$P_{ji} = \frac{\sigma}{\sigma - 1} \beta_{ji} \tag{5.6}$$

Equation *(5.6)* suggests that - for any given market structure - in each country the industry is characterized by an asymmetric equilibrium spectrum of prices, quantities, profits and market shares, distributed according to the values of β_j associated with firms, with lower cost firms having higher profits and larger market shares. Moreover, note that the technological asymmetry between the two countries implies that not only are there differences between equilibrium variables **within** but also **between** countries.

Incumbents will stay in the market as long as their profit is non-negative. Using equation *(5.6)*, this "stay in the market" condition for each country j is

$$\Pi_{ji} = \frac{\varphi A}{N_j} P_j^{\sigma-\eta} \beta_{ji}^{1-\sigma} - K \geq 0 \tag{5.7}$$

where $\varphi=(\sigma-1)^{\sigma-1}\sigma^{-\sigma}$. For any given $N_j=N_j^*$, there will be a level of efficiency $\beta_j=\beta_j^*$ such that $\Pi_{ji}(\beta_j^*,N_j^*)=0$. Thus, β_j^* will be the industry's efficiency cut-off point, which determines the minimum level of efficiency compatible with non-negative profits for any given N_j^*. Those firms whose $\beta_j=\beta_j^*$ are defined as marginal firms; the remaining firms, whose $\Pi_{ji}>0$, will have $\beta_j<\beta_j^*$.

Entry into the industry is modelled as before. After paying the first period's production cost *(K)*, potential entrants will learn the value of their marginal cost β_{ji}. Therefore K represents a sunk cost only for those firms whose $\beta_j \geq \beta_j^*$. As before, these firms will not re-attempt entry. Finally, each potential entrant is assumed to think it will not significantly affect market structure and, through it, the magnitude of the efficiency cut-off point.

The expected profit from entry in the two countries are

$$V_h^E = \int_{1-\delta}^{1+\delta} \Pi_h(\beta_h, N_h^*) \; f(\beta_h) \; d\beta_h \tag{5.8}$$

and

$$V_f^E = \int_{1+\phi-\delta}^{1+\phi+\delta} \Pi_f(\beta_f, N_f^*) \; f(\beta_f) \; d\beta_f \tag{5.9}$$

where V_j^E $(j=h,f)$ is the expected profit of the potential entrant in country j defined over the range of β_j, $\Pi_j(\beta_j, N_j^*)$ is given by equation (5.7) and $f(\beta_j)=1/2\delta$ is the density function of the random variable β_j. Firms will have an incentive to try to enter the industry as long as the expected profit from entry is positive, that is $V_j^E>0$.

In each country, as entry takes place the demand for each variety will *ceteris paribus* fall. The resulting reduction in revenue will force the marginal firms to exit, hence increasing the average efficiency of the industry and lowering the industry price index (P_j). The fall in P_j will raise each firm's demand and induce entry through an increase in the expected profit of a potential entrant (V_j^E). In the free-entry industry equilibrium, market structure no longer changes because no firm has an incentive to attempt entry and no incumbent is forced to leave the market. Adopting the same notation as in Chapter 3, N_j^{**} and β_j^{**} will be the number of firms and the efficiency cut-off point characterizing the steady-state market structure. At these values, the expected profit of any potential entrant is zero and all marginal firms in steady-state will be making zero profits. Hence, in the home country the two conditions defining the steady-state are

$$V_h^E(N_h^{**}) = \int_{1-\delta}^{1+\delta} \left[\frac{\varphi A}{N_h^{**}} P_h^{\sigma-\eta} \beta_h^{1-\sigma} - K \right] f(\beta_h)\, d\beta_h = 0 \tag{5.10}$$

and

$$\Pi_h(N_h^{**}, \beta_h^{**}) = \frac{\varphi A}{N_h^{**}} P_h^{\sigma-\eta} \beta_h^{**1-\sigma} - K = 0 \tag{5.11}$$

Similarly, in the foreign country these will be given by

$$V_f^E(N_f^{**}) = \int_{1+\phi-\delta}^{1+\phi-\delta} \left[\frac{\varphi A}{N_f^{**}} P_f^{\sigma-\eta} \beta_f^{1-\sigma} - K \right] f(\beta_f)\, d\beta_f = 0 \tag{5.12}$$

and

$$\Pi_f(N_f^{**}, \beta_f^{**}) = \frac{\varphi A}{N_f^{**}} P_f^{\sigma-\eta} \beta_f^{**1-\sigma} - K = 0 \tag{5.13}$$

Solving *(5.10)* yields the steady-state number of firms operating in the home country

$$N_h^{**} = \frac{1}{2\delta} \frac{1}{2-\sigma} \frac{\varphi A}{K} P_h^{**\sigma-\eta} \left[\left(1+\delta\right)^{2-\sigma} - \left(1-\delta\right)^{2-\sigma} \right] \tag{5.14}$$

Substituting *(5.14)* into *(5.11)* and solving for β_h^{**} gives the steady-state industry's cut-off-point

$$\beta_h^{**} = \left[\left(\frac{1}{2\delta} \frac{1}{2-\sigma} \right) \left[\left(1+\delta\right)^{2-\sigma} - \left(1-\delta\right)^{2-\sigma} \right] \right]^{\frac{1}{1-\sigma}} \tag{5.15}$$

The corresponding results for the foreign country are

$$N_f^{**} = \frac{1}{2\delta}\,\frac{1}{2-\sigma}\,\frac{\varphi A}{K}\,P_f^{**\sigma-\eta}\left[\left(1+\phi+\delta\right)^{2-\sigma} - \left(1+\phi-\delta\right)^{2-\sigma}\right] \tag{5.16}$$

and

$$\beta_f^{**} = \left[\left(\frac{1}{2\delta}\,\frac{1}{2-\sigma}\right)\left[\left(1+\phi+\delta\right)^{2-\sigma} - \left(1+\phi-\delta\right)^{2-\sigma}\right]\right]^{\frac{1}{1-\sigma}} \tag{5.17}$$

Note that in equations *(5.14)* and *(5.16)*, P_h^{**} and P_f^{**} depend on β_h^{**} and β_f^{**} respectively. In fact, from equation *(5.2)*, the steady-state price index for the home country is

$$P_h^{**} = \frac{\sigma}{\sigma-1}\left(\frac{\beta_h^{**2-\sigma} - (1-\delta)^{2-\sigma}}{(2-\sigma)\ (\beta_h^{**}-1+\delta)}\right)^{\frac{1}{1-\sigma}} \tag{5.18}$$

Analogously, for the foreign country,

$$P_f^{**} = \frac{\sigma}{\sigma-1}\left(\frac{\beta_f^{**2-\sigma} - (1+\phi-\delta)^{2-\sigma}}{(2-\sigma)\ (\beta_f^{**}-1-\phi+\delta)}\right)^{\frac{1}{1-\sigma}} \tag{5.19}$$

As shown in Chapter 3, for the home country $1-\delta\leq\beta_h^{**}<1$. Similarly, for the less efficient country $1+\phi-\delta\leq\beta_f^{**}<1+\phi$ holds for all $\sigma>1$, $0<\delta<1$ and $0<\phi<\delta$. This suggests that entry will continue as long as $E(\beta_j)\leq\beta_j^{*}$, *i.e.* potential entrants' expected efficiency must not be lower than the minimum efficiency required to be profitable given market conditions.

The next two sections highlight the main features of the foreign country's steady-state. Given the tedious algebra involved - as in

Chapter 3 - we shall make use of numerical simulation to analyze the properties of some of the expressions. The same parameters intervals as in Chapter 3 have been considered for δ, σ and η[1]. Additionally, several values of the efficiency gap have been analyzed, *i.e.* $\phi=(0.01, 0.03,\ldots, 0.21)$.

5.4. COMPETITION, ENDOGENOUS EFFICIENCY AND CONCENTRATION

For any given values of δ and σ the steady-state industry will be characterized by a spectrum of efficiencies defined over the interval $[1-\delta,\beta_h^{**}]$ in the home country and $[1+\phi-\delta,\beta_f^{**}]$ in the foreign country.

For any **given value of the efficiency gap** ϕ, in both countries the steady-state market structure will depend on the parameters σ and δ. It can be very easily shown that Propositions 3.1-3.3 in Chapter 3 hold for the foreign country as well. For the sake of clarity, we summarize here the main results of the propositions with emphasis on the foreign country's variables.

(1) Entry and exit into the industry will affect the extent of technical asymmetry among firms within each industry, but will not eliminate it. As a result, the process of competitive selection will neither equalize nor eliminate supernormal profits. The expected surplus profit of a surviving firm in the foreign country will be given by

$$R_f^{**} = \int_{1+\phi-\delta}^{\beta_f^{**}} \Pi(\beta_f,N_f^{**})\; g_f(\beta_f)\; d\beta_f \tag{5.20}$$

[1] These are $\delta=(0.05,\ldots,0.95)$, $\sigma=(1.1,\ldots,6.1)$ and $\eta=(0.1,\ldots,1.5)$, with $\sigma>\eta$ being always imposed.

where $g_f(\beta_f)=1/(\beta_f^{**}-1-\phi+\delta)$, and which is positive for all values of σ and δ. Consequently, $0 \leq M(\beta_{fi}) \leq M(1+\phi-\delta)$ - where $M(\beta_{fi})$ is the steady-state profit margin of a firm i in the foreign country.

(2) The minimum efficiency required to survive in steady-state is, in both countries, positively related to the degree of heterogeneity amongst firms and to the elasticity of substitution between varieties. Hence, both β_h^{**} and β_f^{**} are decreasing functions of both δ and σ. Given the role of these parameters in determining the **toughness** of price competition, we can conclude that the steady-state efficiency is higher the fiercer is competition.

(3) The larger is the steady-state efficiency, the higher will be the degree of market concentration measured by the Herfindhal's index, which for the foreign country will be given by

$$H_f^{**} = N_f^{**}\ V(S_{fi}) + \frac{1}{N_f^{**}} \tag{5.21}$$

where S_{fi} the market share of a firm i in the foreign country and $V(S_{fi}) = \int_{1+\phi-\delta}^{\beta_f^{**}} \left(S_{fi}-E[S_{fi}]\right)^2 g(\beta_f)d\beta_f$. Also, the industry average profitability will be positively related to the steady-state degree of concentration and average level of efficiency.

5.5. EFFICIENCY DISADVANTAGE AND MARKET STRUCTURE

As stated in Section 5.4., **for any given efficiency gap** (ϕ), the behaviour of the two countries' steady-state variables is the same.

That is, the parameters determining the importance of price competition have the same impact on the long-run industry structure of the two industries. We now turn to analyze how the existence of an efficiency disadvantage affects the foreign country's steady-state. Assuming all the other parameters to be given, we shall look at how changes in the size of the efficiency gap[2] would affect the foreign country's long-run equilibrium.

5.5.1. Steady-state industry efficiency and profitability

Ceteris paribus, the larger is ϕ the lower will be the **mean** efficiency characterizing the state of technology of the foreign industry, *i.e.* $E(\beta_{fi})=1+\phi$ is increasing in ϕ. Also,

> **Proposition 5.1:** The larger is its efficiency disadvantage the lower will be the industry's steady-state efficiency and profitability.

By direct differentiation, β_f^{**} is clearly an increasing function of ϕ, *i.e* the larger is the efficiency gap the lower will be the minimum level of efficiency required to survive in steady-state. Furthermore, the lower minimum efficiency associated with higher values of ϕ will be reflected in higher industry price levels, that is $\frac{dP_f^{**}}{d\phi}>0$. The steady-state efficiency cut-off point and price index have been plotted in Figures 5.2 and 5.3 respectively. The expected surplus profit of a surviving firm (R_f^{**}), given by equation *(5.20)* has been plotted against ϕ in Figure 5.4. For any value of σ and δ, the expected profit of a surviving firm is a decreasing function of the

[2] Note that, given the shape of the functions involved, economic feasibility imposes constraints on the values of ϕ relative to δ.

size of the efficiency gap. A measure of the expected total industry profit, defined as $T_f^{**}=(N_f^{**}R_f^{**})$, has also been computed. It can be shown that $\frac{dT_f^{**}}{d\phi}<0$, thus indicating that, whatever is the sign of $\frac{dN_f^{**}}{d\phi}$, the fall in the expected profit of an individual firm will be reflected in the total industry profit.

Finally, note that *ceteris paribus* an increase in ϕ lead to a steady-state increase in the variability of technologies and prices. The former is evident from the variance of steady-state marginal costs given by

$$V(\beta_{fi}) = \int_{1+\phi-\delta}^{\beta_f^{**}} \beta_{fi}\ g_f(\beta_f)\ d\beta_f$$

$$= \frac{\beta_f^{**3} - (1+\phi-\delta)^3}{3\ (\beta_f^{**}-1-\phi+\delta)} - \left(\frac{\beta_f^{**2} - (1+\phi-\delta)^2}{2\ (\beta_f^{**}-1-\phi+\delta)}\right)^2 \tag{5.22}$$

Numerical evaluation of equation *(5.22)* indicates that steady-state variability of technology is an increasing function of ϕ for all values of δ, σ and η within the intervals of interest (see Figure 5.5). The variability of prices will be measured by

$$V(P_{fi}) = \int_{1+\phi-\delta}^{\beta_f^{**}} P_{fi}\ g_f(\beta_f)\ d\beta_f$$

$$= \left(\frac{\sigma}{\sigma-1}\right)^2 V(\beta_{fi}) \tag{5.23}$$

Clearly, $V(P_{fi})$ is a monotonic transformation of $V(\beta_{fi})$ and thus its behaviour with respect to comparative static changes in ϕ reflects that of the marginal cost variability. So, as the efficiency gap suffered by the country increases, due to an exogenous increase in the mean of its marginal cost distribution, the steady-state dispersion of efficiencies and prices will also increase. This, together with the fall in the marginal firms' efficiency, clearly indicates a reduction of the industry's overall efficiency.

5.5.2. Market concentration

A slightly more complex and less intuitive behaviour is shown by the foreign country's steady-state market structure with respect to the magnitude of the efficiency gap.

Our analysis suggests that an increase in the size of the efficiency gap, whilst reducing efficiency, does not always reduce industry concentration. In particular, the nature of the effects of comparative static changes in ϕ on concentration depends on the toughness of price competition and on the size of the price elasticity of aggregate demand.

Proposition 5.2: If price competition is sufficiently tough *ceteris paribus* increases in the size of the efficiency gap reduce industry concentration.

Numerical evaluation of the steady-state Herfindhal's index for the foreign country, given by equation *(5.21)*, shows that if σ and/or δ are sufficiently large, $\frac{dH_f^{**}}{d\phi}<0$ for all values of η. This is illustrated in Figure 5.6. Recalling that β_f^{**} increases in ϕ, this results confirms the general relationship between concentration and industry efficiency highlighted so far and reflects a positive relationship between number of firms and magnitude of the efficiency gap (see Figure 5.7).

Proposition 5.3.: When price competition is not very tough (*i.e.* for sufficiently small values of σ and/or δ), increases in the size of the efficiency gap will *ceteris paribus* **(1)** reduce concentration if the price elasticity of demand is sufficiently low and **(2)** increase concentration if the price elasticity of aggregate demand is sufficiently large.

The analysis of the Herfindhal's under conditions of low price competition shows that $\frac{dH_f^{**}}{d\phi}<0$ for sufficiently small η and $\frac{dH_f^{**}}{d\phi}>0$ otherwise. These results are illustrated in Figures 5.8 and 5.9 respectively. It can be proved that $V(S_{fi})$ is a monotonically decreasing function of ϕ for all values of η. Clearly, for the second part of the proposition to hold, *ceteris paribus* increases in the efficiency gap must lead to a reduction in the number of firms sufficient to more than compensate the effects on concentration of $\frac{dV(S_{fi})}{d\phi}<0$. Indeed, although one would expect the number of firms in the industry to increase as a result of the lower efficiency associated with increasing values of ϕ, $\frac{dN_f^{**}}{d\phi}$ becomes negative if - with σ and δ sufficiently low - aggregate demand is sufficiently elastic. Figures 5.10 and 5.11 illustrate this point[3].

---

[3] Note that $\frac{dN_f^{**}}{d\phi}$ will change sign at lower values of ϕ the larger is η. For example, for $\eta \geq 1.3$, $\frac{dN_f^{**}}{d\phi}<0$ for all values of ϕ within the interval under consideration.

Now, whilst σ and δ - which determine, **for any given** ϕ, the level of the steady-state efficiency and price index - embody the **rationalizing** nature of price competition and exert a force towards concentration, ϕ reduces the strength of this force and limits the extent to which competition can rationalize industry. In a sense, ϕ can be seen as reducing the level of economic activity at the industry level. If price competition is not very tough, the effect of ϕ on industry efficiency dominates. Recall that $\frac{dN_f^{**}}{d\phi}<0$ occurs when price competition is low and η is large: price competition does not exert a sufficient pressure towards industry rationalization and concentration and efficiency is further reduced by the comparative statics increases in ϕ. In these circumstances, the fall in the number of firms simply reflects a **lower level of economic activity** which the industry generates as a result of which the market can simply sustain a smaller number of operating firms. Furthermore note that ϕ affects aggregate demand *via* the industry price index, with $\frac{dD}{dP_f^{**}}<0$. Hence, given that $\frac{dP_f^{**}}{d\phi}>0$, the higher is ϕ the lower will be aggregate demand. However, the impact of ϕ on D will be smaller the smaller is η. As a result, the larger is η the larger will be the reduction in aggregate demand generated by a given increase in ϕ through a higher price index.

It is worth noting that **for any given degree of the toughness of price competition**, the number of firms which the industry can sustain will be smaller the lower is aggregate demand[4]. Hence, the fall in

---

[4] This can be seen by writing N_f^{**} in terms of D. It will be clear that as D falls the steady-state number of firms also reduces.

the number of firms here stems from a **fall in efficiency**. If the extent of price competition is low, because varieties are not close substitutes for one another and/or because firms' costs are characterized by a high degree of homogeneity, the industry price index will be large; in these circumstances a high price elasticity of aggregate demand will imply that a small number of firms will be sustained by the market. The industry will look concentrated, not as a result of a high efficiency but as a result of a low efficiency. The market will simply be characterized by a **smaller number of smaller firms**.

This analysis is confirmed by considering the expected output of a firm in steady-state, that is

$$Y_f^{**} = \int_{1+\phi-\delta}^{\beta_f^{**}} D(\beta_f, N_f^{**})\; g_f(\beta_f)\; d\beta_f \tag{5.24}$$

Proposition 5.4: The larger is the efficiency disadvantage the country suffers, the lower will be the expected size of a surviving firm.

Y_f^{**} is plotted against ϕ in Figure 5.12. Note that Y_f^{**} is invariant with respect to η and $\frac{dY_f^{**}}{d\phi}<0$ holds even for those values of δ and σ for which $\frac{dN_f^{**}}{d\phi}<0$. In other words, even when the steady-state number of firms falls as ϕ increases, the expected size of the surviving firm falls. This confirms the fact that whilst σ and δ which determine the toughness of price competition do indeed foster concentration in the sense of a **smaller number of larger firms**, the increase in ϕ generates a **smaller number of smaller firms** in a situation characterized by a lower level of economic activity[5].

5.5.3. Some policy implications: A digression

Although it is not one of the aims of this work to deal with issues of industrial policy, it is worth to highlight in passing some of the possible policy implications of this analysis. For instance, it is possible to envisage situations where a government may want to attempt to increase the average industry efficiency by means of instruments such as training or research and development subsidies to firms. In the present context, this type of intervention could be directed to lower the mean of the efficiency distribution, *i.e.* reduce the size of ϕ.

Clearly, changes in the size of ϕ have effects on welfare. As far as consumers are concerned, there are two channels through which the magnitude of the mean of the efficiency distribution (determined by ϕ) affects welfare, namely the industry price index and the number of varieties. From our previous analysis we know that the industry price index is monotonically increasing in ϕ which implies that consumer welfare is higher the smaller is ϕ. As a result, an industrial policy aimed at increasing the average efficiency of the state of technology (*i.e.* reducing ϕ) is always desirable from a welfare point of view given its price reducing effects. However, as far as the number of varieties is concerned, we saw that the sign of $\frac{dN_f^{**}}{d\phi}$ is not unique but depends on the structural parameters of the model. As a result, the net effect on consumer welfare of a reduction

5 Note that the expected output is only meant to provide a first approximation of firm size.

in ϕ is definitely positive when $\frac{dN_f^{**}}{d\phi}<0$, because both the price and number of varieties effects of the increased efficiency on consumer welfare are positive. As we saw, $\frac{dN_f^{**}}{d\phi}<0$ occurs when price competition is not very tough - *e.g.* if, for any given δ, there is a small elasticity of substitution between varieties (σ) and if aggregate demand is price elastic. However, when the parameters of the model are such that $\frac{dN_f^{**}}{d\phi}>0$, a reduction of ϕ will have a negative impact on welfare *via* a reduction of the number of varieties available for consumption. In this case, the change in net consumer welfare will depend on which of the price and number of varieties effects prevails. In these circumstances, the determination of the net consumer welfare effect of a (policy induced) reduction in ϕ requires the evaluation of the indirect utility function. As in equation *(3.64)*, the latter can be obtained by substituting equilibrium demand and price into the utility function in *(5.1)*. This will yield

$$W_f = A\ N_f^{**1/(\sigma-1)} P_f^{-\eta} \tag{5.25}$$

which has been numerically evaluated within the usual parameter intervals. When $\frac{dN_f^{**}}{d\phi}>0$ the reduction in the number of firms brought about by lower values of ϕ will more likely be associated with increases in consumer welfare the larger are, *ceteris paribus*, σ and/or δ. In other words, it is more likely that the efficiency-led price effect on consumer welfare will dominate the variety effect when price competition is tougher. These points are illustrated in Figures 5.13, 5.14 and 5.15. As a result, an efficiency increasing industrial policy may not lead to consumers being better off if price competition is not sufficiently tough. Clearly, given that $\frac{dT_f^{**}}{d\phi}<0$ always holds, a reduction of ϕ will increase total industry welfare with certainty only if price competition is sufficiently tough. Due to its adverse impact on consumer welfare when price competition is not very tough, a fall in ϕ may not lead to an overall welfare gain[6].

5.6. COMPARING THE TWO COUNTRIES STEADY-STATES

In this section the two industries steady-state market structures are compared. The relative autarkic situation of the two countries will offer a useful benchmark for the assessment of the effects of free-trade carried out in the next chapter.

5.6.1. Efficiency

For positive values of the efficiency gap between countries *(ϕ)*, other things being equal, the average industry efficiency of the home country will be higher than that of the foreign country. This can be verified by comparing the steady-state efficiency cut-off-point in the two countries.

> **Proposition 5.5:** A lower minimum efficiency is required to survive in steady-state in the country which has the efficiency disadvantage than in the more efficient country.

For $\phi>0$, $\beta_h^{**}<\beta_f^{**}$ holds for all values of the other relevant parameters and the difference between them is positively related to the size of ϕ[7]. The two cut-off points are plotted in Figure 5.16.

---

6 Given that this is not an essential issue in this analysis, we do not go any further in examining its consequences here.

7 Let $\Delta=\beta_h^{**}-\beta_f^{**}$. Clearly, $\Delta=0$ if $\phi=0$. Given that β_h^{**} is invariant

Consistently, the different average efficiency levels are reflected in the existence of a price differential between the two industries, with $P_h^{**}<P_f^{**}$, which increases in ϕ and holds for all values of the relevant parameters. P_h^{**} and P_f^{**} are shown in Figure 5.17.

The lower efficiency at the industry level is also reflected in a lower economic efficiency at the firm level. The latter can be approximated by the extent to which potential economies of scale internal to the firm are exploited. Following Helpman and Krugman (1985), to measure the degree of scale economies we shall use the inverse of the elasticity of cost with respect to output, that is the average cost to marginal cost ratio, *i.e.* $\theta=\partial logQ/\partial logC$. Within our framework, this elasticity of scale for a firm i in country j will be given by $\theta_{ji} = 1 + K/\beta_{ji}Q_{ji}$, where $Q_{ji}=D_{ji}$ is given by equation *(5.3)*[8]. Given the heterogeneity of firms assumed in this model, the inter-country comparison of the degree of exploitation of potential economies of scale will be carried out, as usual, with respect to the expected steady-state values. For a surviving firm in country j, the expected elasticity of scale will be given by

$$E(\theta_{ji}) = \int_{a_j}^{\beta_j^{**}} \left(1 + K/\beta_{ji}D_{ji}(N_j^{**})\right) g_j(\beta_j)\, d\beta_j \qquad (5.26)$$

---

with respect to ϕ, and given that $d\beta_f^{**}/d\phi<o$, it follows that $d\Delta/d\phi>0$. Hence, $\Delta>0$ if $\phi>0$.

8 A note of caution is required. Given a production function $Q=f(v)$, as pointed out by Hanoch (1975), the cost-based index of scale economies will correspond to the output-based elasticity, *i.e.* $\partial logf(\lambda v)/\partial log\lambda = \partial logQ/\partial logC(v)$, at every minimum cost point in the input space. However, their change with respect to output will only coincide if the production function is homothetic.

where $a_h=1-\delta$, $a_f=1+\phi-\delta$ and $g_j(\beta_j)=1/(\beta_j^{**}-a_j)$.

Proposition 5.6: The scale of production at the firm level is more efficient in the country which enjoys a favourable efficiency gap.

We have evaluated the ratio $E(\theta_{hi})/E(\theta_{fi})$ within the usual parameter intervals. Our results show that the degree of scale economies is always higher in the home than in the foreign country, with $E(\theta_{hi})<E(\theta_{fi})$ for all values of the relevant parameters (see Figure 5.18 for an illustration). Hence, due to the foreign country's efficiency disadvantage, a surviving firm will reach a smaller scale of production than in the home country.

5.6.2. Concentration

Despite its higher efficiency, the more efficient industry is not always characterized by a higher degree of market concentration. Instead, the relative degree of market concentration in the two countries depends on the toughness of price competition and on the price elasticity of aggregate demand.

Proposition 5.7: If price competition is sufficiently tough (*i.e.* for sufficiently large values of σ and δ), concentration is higher in the more efficient country than in the less efficient one.

Proposition 5.8: If the degree of price competition is sufficiently low, **(1)** concentration is higher in the more efficient country than in the less efficient one for sufficiently small values of η; **(2)** concentration is lower in the more efficient country for sufficiently large values of η.

For all values of σ, δ, η and ϕ within the relevant parameter intervals, size variability, measured by the variance of market shares in terms of value, is larger in the home country than in the foreign one. The number of firms, however, behaves in a less straightforward fashion. As explained before, when price competition is tough, the lower efficiency characterizing the foreign country translates into a larger number of firms operating there than in the home one. This can be seen from the numerical evaluation of the ratio N_h^{**}/N_f^{**} which - for sufficiently large σ and/or δ - is smaller than one for all values of ϕ and η (see Figure 5.19). As a result, a higher concentration in the home country will emerge with $H_h^{**}>H_f^{**}$ for all values of ϕ and η. The ratio $H_h^{**}>H_f^{**}$ is plotted in Figure 5.20.

If, however, price competition is not very tough, the number of firms in the home country is larger than in the foreign one for sufficiently large values of the price elasticity of aggregate demand. As was argued in the previous section, in these circumstances, the effects of a positive ϕ on the number of firms outweighs the impact of those parameters which, *via* price competition, embody the rationalizing effects on industry efficiency: the market in the foreign country can simply **sustain** a smaller number of varieties, thus accounting - in these circumstances - for a larger concentration index in that country. Figures 5.21 and 5.22 illustrate these points.

This line of argument is supported by our findings of Sub-section 5.6.1., which show how the expected degree of exploitation of scale economies is lower in the foreign than in the home country. Consistently, the expected output level of a surviving firm in the home country is always larger than in the foreign one, regardless of the relative market structure in the two industries. This can be seen by comparing the expected output of a surviving firm in the foreign country Y_f^{**} in equation *(5.24)* to that of the home country, that is

$$Y_h^{**} = \int_{1-\delta}^{\beta_h^{**}} D(\beta_h, N_h^{**})\ g_h(\beta_h)\ d\beta_h \tag{5.27}$$

where $g_h(\beta_h)=1/(\beta_h^{**}-1+\delta)$. The ratio (Y_h^{**}/Y_f^{**}) can be shown to be greater than one for all values of the relevant parameters[9].

To summarize, if price competition is sufficiently low the role of the efficiency gap in depressing the level of economic activity may dominate the lack of rationalizing effects of price competition on market structure and limit the number of firms sustainable by the market. In other words, if there is a *ceteris paribus* reduction of price competition (*i.e.* σ and/or δ fall) both countries will experience a fall in the steady-state industry efficiency and this will result in a reduced pressure towards market concentration. In the home country, this pressure will always take the form of an increase in the number of firms. A larger number of smaller firms will survive. In the foreign country, the reduction of concentration may occur in a different fashion, with a smaller number of smaller firms surviving in steady-state. If efficiency in the industry falls to sufficiently low levels, due to the joint action of a low price competition and of an efficiency disadvantage, the industry will be

[9] This relationship is unaltered when looking at the expected outputs at the industry level, $(N_h^{**} Y_h^{**})$ and $(N_f^{**} Y_f^{**})$. Hence, the volume of goods produced in the more efficient industry is always larger than in the less efficient one, even when a larger number of varieties is produced in the latter.

able to sustain a smaller number of firms than in the more efficient country. In these circumstances, whilst the home country experiences an increase in the number of firms, the foreign country will witness a reduction of the number of surviving firms.

5.6.3. Profitability

Clearly, the lower efficiency and the resulting higher price index of the foreign country will have a negative impact on aggregate demand. The extent of this effect is directly related to the size of the price elasticity of demand *(η)*. As a result, the smaller is η, the smaller will be the depressing effect on relative market structure of a the higher price index.

Proposition 5.9: The more efficient country is characterized by a higher steady-state profitability.

Equations *(3.26)* and *(5.20)* have been evaluated for the usual parameter intervals and indicate that $R_h^{**} > R_f^{**}$ always holds. The higher profitability of the more efficient country is confirmed at the **aggregate level**. As a proxi for total industry profitability we have used the measure $T_j^{**} = N_j^{**} R_j^{**}$. Regardless of whether N_h^{**} is greater or smaller than N_f^{**}, total industry profits are always larger in the more efficient country, with the gap increasing in ϕ, indicating that the difference in the expected profit more than compensates for the difference in the number of firms when $N_h^{**} < N_f^{**}$.

5.7. AN INTER-COUNTRY WELFARE COMPARISON

The impact of the existence of the efficiency gap *(ϕ)* between countries on their relative efficiency, market structures and profitabilities will clearly be a source of welfare differences as well. In particular, given its efficiency advantage over the foreign country, the home country will enjoy a relatively higher purchasing power of any given income. However, as we saw before, there are circumstances in which the latter is characterized by a larger number of surviving firms and hence offers a wider choice to consumers whose utility function rewards product variety. It follows that it is difficult, *a priori*, to establish which one of the variety and price effects prevails and under which circumstances this occurs. To analyze this the two countries' indirect utility functions, have been employed. These are determined by substituting the respective equilibrium demands and prices of the two industries into the common utility function in *(5.1)* and writing it in terms of P_j^{**} $(j=h,f)$[10]. We have numerically analyzed the ratio

$$\frac{W_h}{W_f} = \left(\frac{P_f^{**}}{P_h^{**}}\right)^{\eta} \left(\frac{N_h^{**}}{N_f^{**}}\right)^{1/(\sigma-1)} \tag{5.28}$$

for the usual parameters intervals.

> **Proposition 5.10:** For sufficiently low levels of price competition and for sufficiently small values of the price elasticity of demand η consumers in the more efficient country are worse off than in the less efficient one.

Our results show that in the majority of cases the higher efficiency of the home country generates a higher consumer welfare than in the

---

10 See equation *(3.64)* in Chapter 3 for details.

foreign one. However, when the price elasticity of aggregate demand and the elasticity of substitution between varieties are sufficiently small foreign consumers are better off. The ratio in equation (5.28) is plotted for a high and for a low level of price competition (determined by the magnitude of δ and σ) in Figures 5.24 and 5.25 respectively. From Section 5.4.2, we know that $N_f^{**} > N_h^{**}$ will hold for sufficiently low degree of price competition and for a sufficiently non-elastic aggregate demand. In these circumstances, foreign consumers are better off in terms of number of available varieties. Also, given that P_j^{**} is not affected by η, the impact of given price differences on relative consumer welfare is smaller the smaller is η. It follows that for low values of the price elasticity of aggregate demand the favourable difference in the number of firms - and varieties - will more than compensate the lower purchasing power of foreign consumers making them better off than home consumers. As η increases, however, the price disadvantage becomes more important and will eventually dominate[11]. Moreover, note that the smaller is σ the more important is variety in consumers' utility. This will correspond to a larger impact on $\frac{W_h}{W_f}$ of the difference in the number of firms relative to differences in prices between the two countries, thus explaining the fact that for sufficiently small σ the higher number of varieties of the foreign country dominates the role of its higher price in determining relative welfare.

As was argued in Chapter 3, the persistence of positive profits

---

[11] Clearly, when η is sufficiently large and $N_h^{**} > N_f^{**}$, $W_h^{**} > W_f^{**}$ unambiguously holds, given that home consumers are better off both in terms of price and number of varieties.

in the long-run industry equilibrium implies that any welfare analysis needs to take producer surplus into account. For completeness, the overall industry welfare measure defined in equation *(3.70)* can now be used to compare the two industries' total welfare. This implies examining the the ratio

$$\frac{W_h^{\Delta}}{W_f^{\Delta}} = \frac{W_h + \dfrac{N_h^{**}}{P_h^{**}} R_h^{**}}{W_f + \dfrac{N_f^{**}}{P_f^{**}} R_f^{**}} \tag{5.29}$$

Note that, as shown in the previous section, for all values of the relevant parameters the home country is characterized by higher expected firm and total industry profits, regardless of the relative market size of the two industries. Hence, given that $\dfrac{P_f^{**}}{P_h^{**}}>1$ always holds, it follows that $\dfrac{N_h^{**}}{P_h^{**}} R_h^{**}$ is always greater than $\dfrac{N_f^{**}}{P_f^{**}} R_f^{**}$. Our numerical analysis, however, suggests that in those circumstances in which $W_f > W_h$, $W_f^{\Delta} > W_h^{\Delta}$ also holds. This implies that when the price effect is dominated by the variety effect in the determination of relative consumer welfare, the latter also outweighs the relative producer welfare. See Figures 5.26 and 5.27 for an illustration.

5.8. CONCLUSIONS

While setting the basis for the development of a trade model between two similar but not identical countries, this chapter has extended the market structure implications of technical heterogeneity between firms to an inter-industry comparison. Some elements affecting market structure have been brought out more clearly. First, we have shown that market concentration results from the interplay of two factors. On one hand, there is the rationalizing effect of price competition which - by increasing efficiency - pushes towards a reduction of the surviving number of firms. This force implies that in a less efficient industry rationalization will be smaller and the number of firms will be larger. On the other hand, there is the effect on market structure which the level of industry efficiency exerts *via* aggregate demand. The higher is efficiency, the lower is the price index and - other things equal - the larger will be aggregate demand and the number of firms the industry can sustain. This force implies a tendency towards a smaller number of firms surviving in the less efficient market steady-state. Furthermore, the analysis of the role of the efficiency gap between industries has enabled us to explicitly highlight the role of firm size in shaping market concentration. Even when the low price competition and the low level of economic activity of the less efficient country result in it having a smaller number of firms than the more efficient one, the relationship between industry efficiency and concentration highlighted in Chapter 3 is not overturned; the less efficient industry will have a smaller number of smaller firms.

Finally, the analysis of this chapter also opens interesting industrial policy issues. Clearly, our brief discussion of these issues is far from being exhaustive. However, the fact that our analysis suggests that an industrial policy aimed at increasing the efficiency of the industry's state of technology (by reducing the mean of the marginal cost distribution) may not always have desirable welfare effects indicates the scope for fruitful research aimed at further exploration of the complexity of the forces at work.

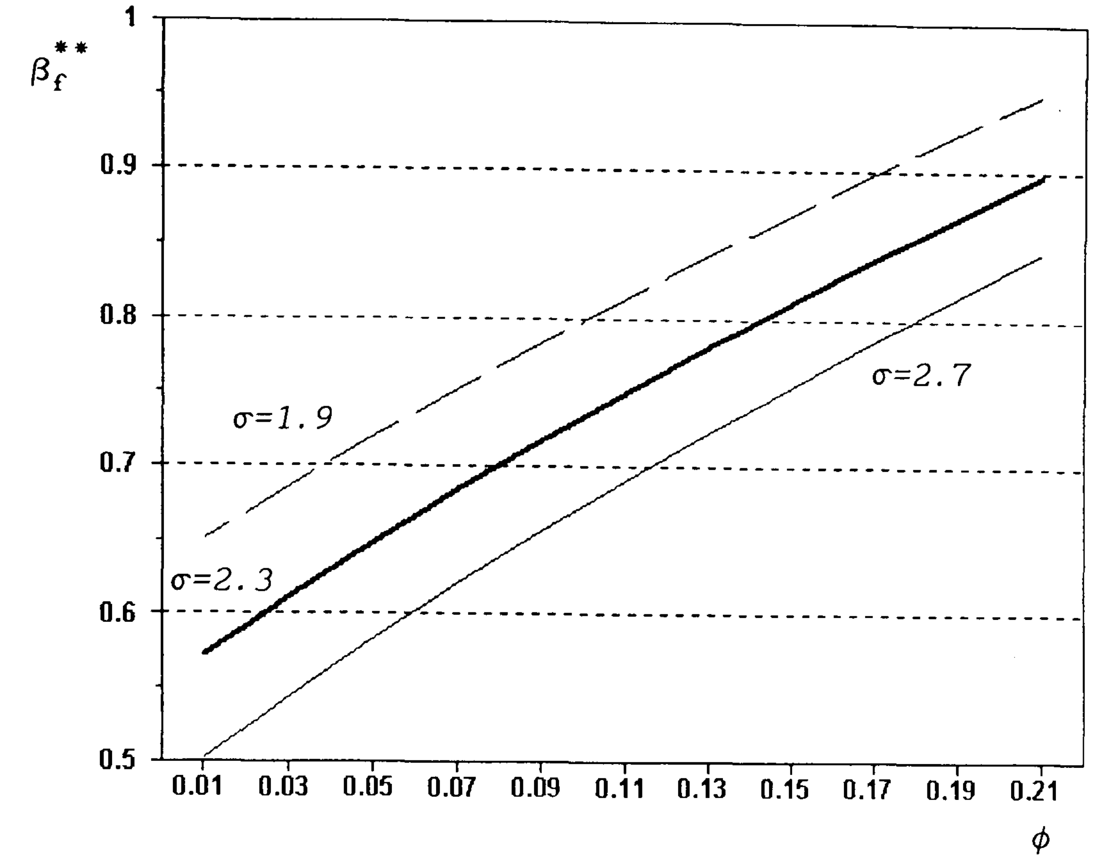

Fig. 5.2: Foreign country

Steady-state efficiency cut-off point *(δ=0.9)*

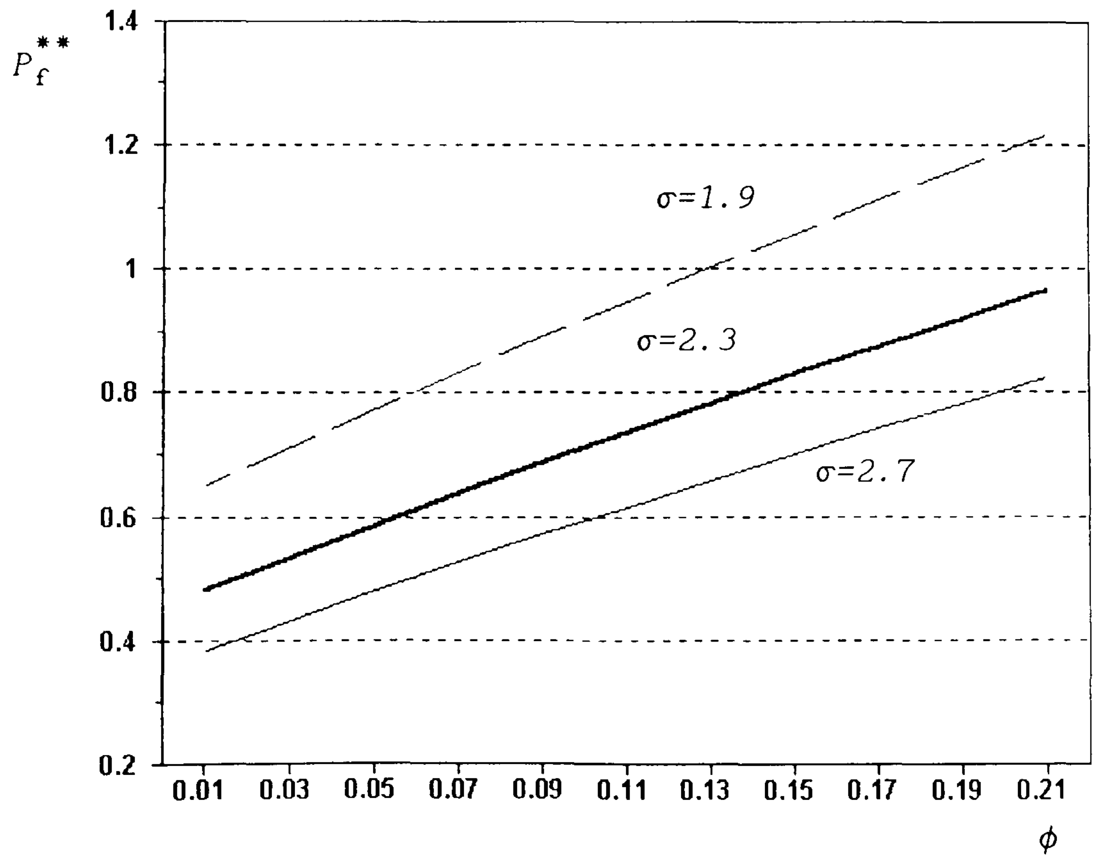

Fig. 5.3 Foreign country

Steady-state price index *(δ=0.9)*

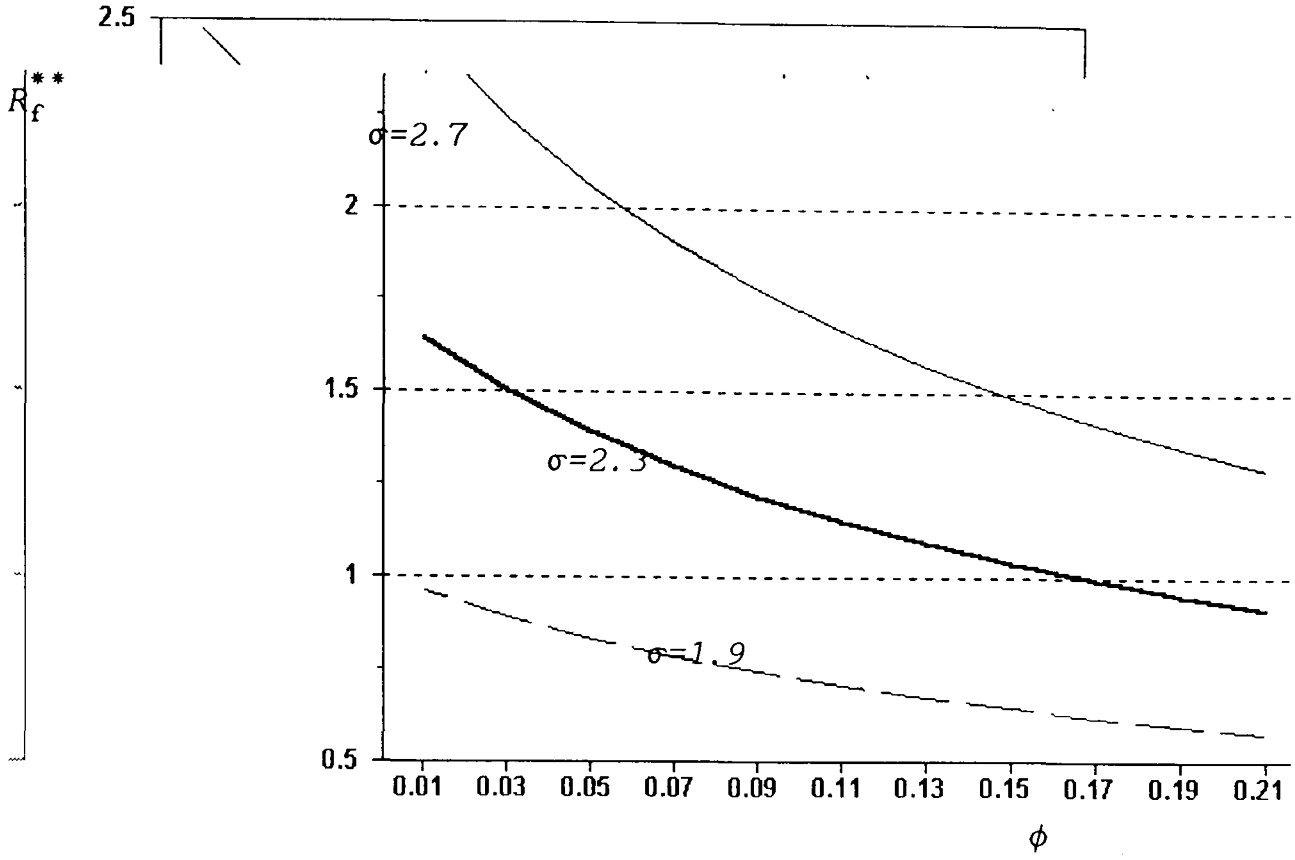

Fig. 5.4 Foreign country

Steady-state expected profit *(δ=0.9, η=1)*

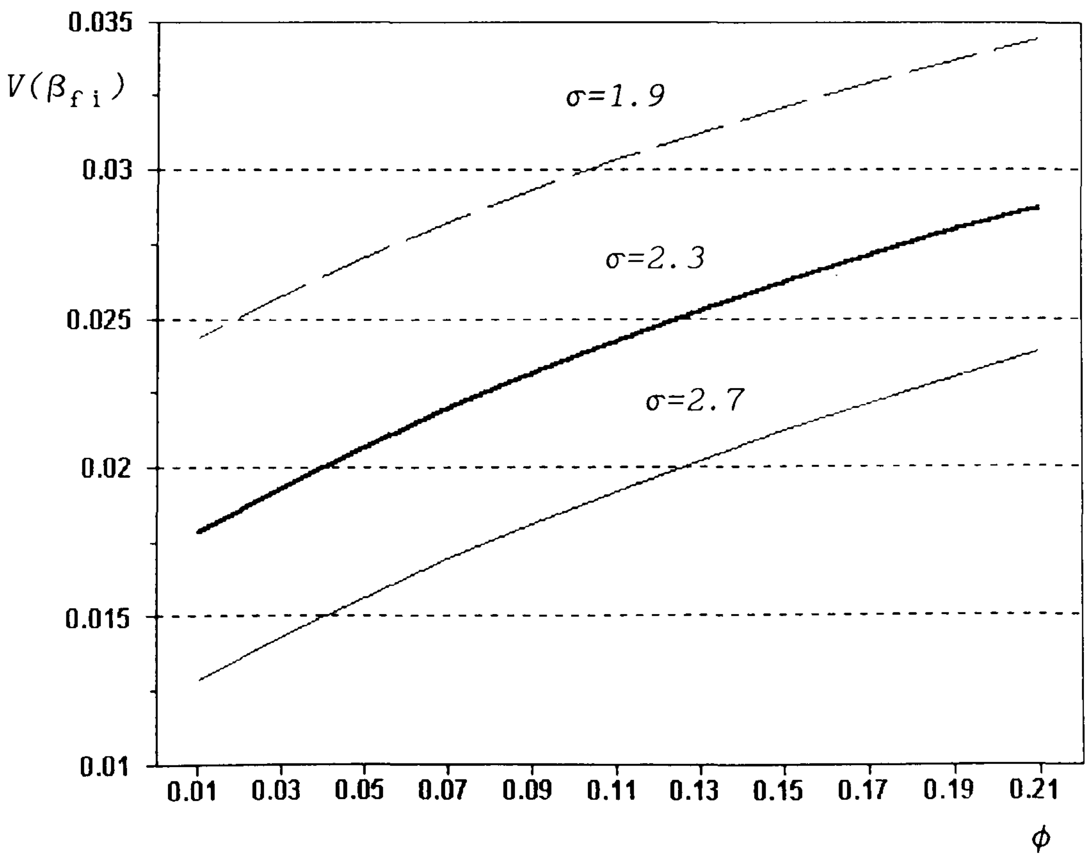

Fig. 5.5 Foreign country

Steady-state marginal cost variability *(δ=0.9)*

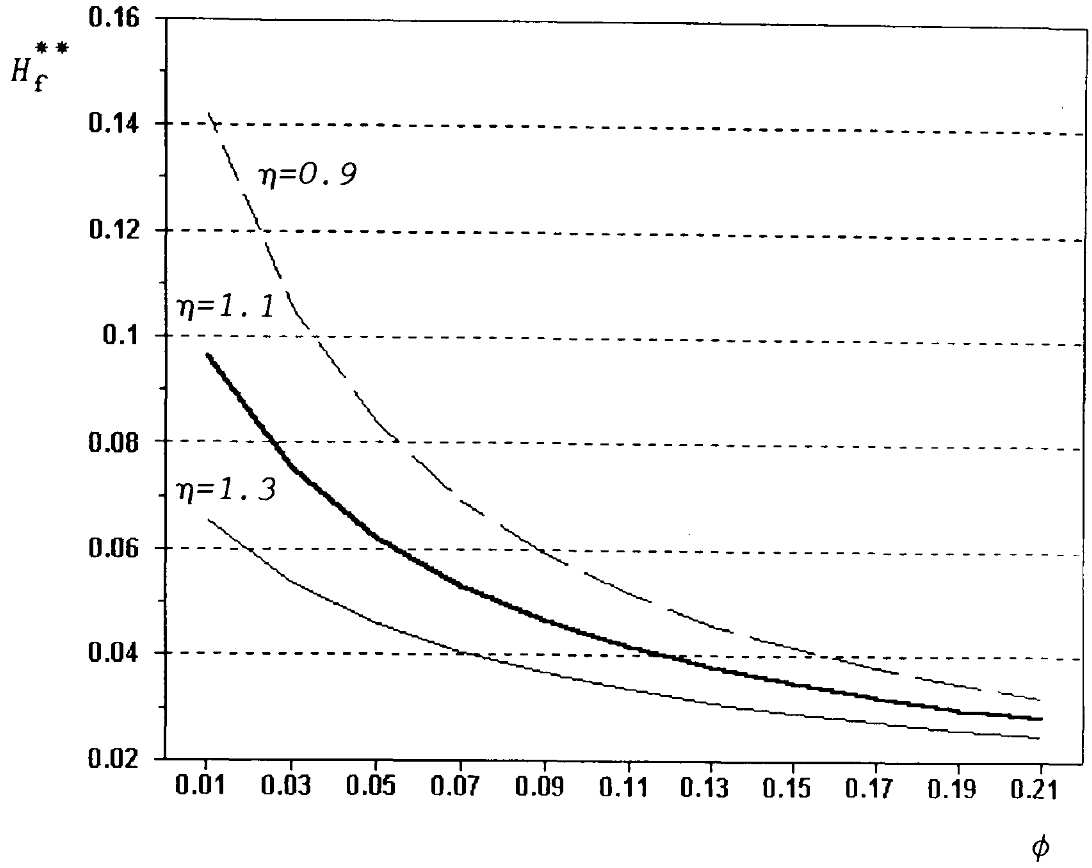

Fig. 5.6 Foreign country

Steady-state industry concentration *($\delta=0.95$, $\sigma=4.1$)*

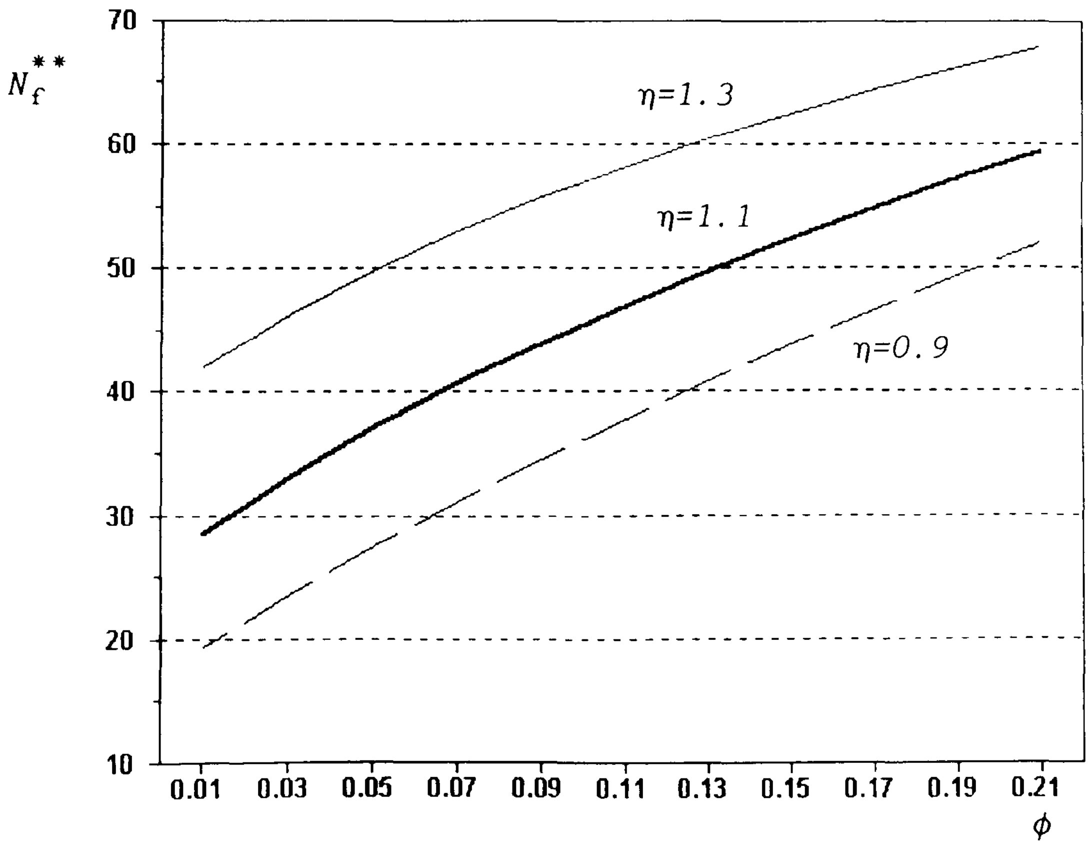

Fig. 5.7 Foreign country

Steady-state number of firms *($\delta=0.95$, $\sigma=4.1$)*

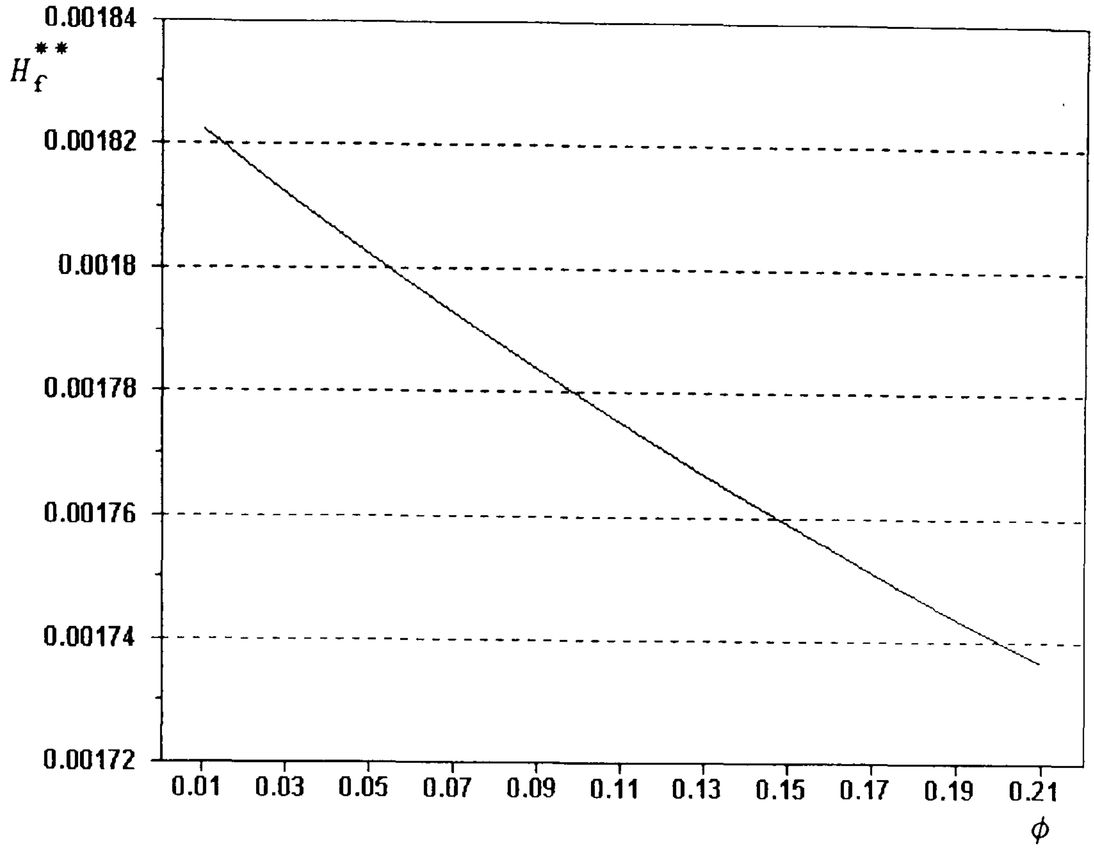

Fig. 5.8 Foreign country

Steady-state industry concentration *(δ=0.35, σ=1.7, η=0.9)*

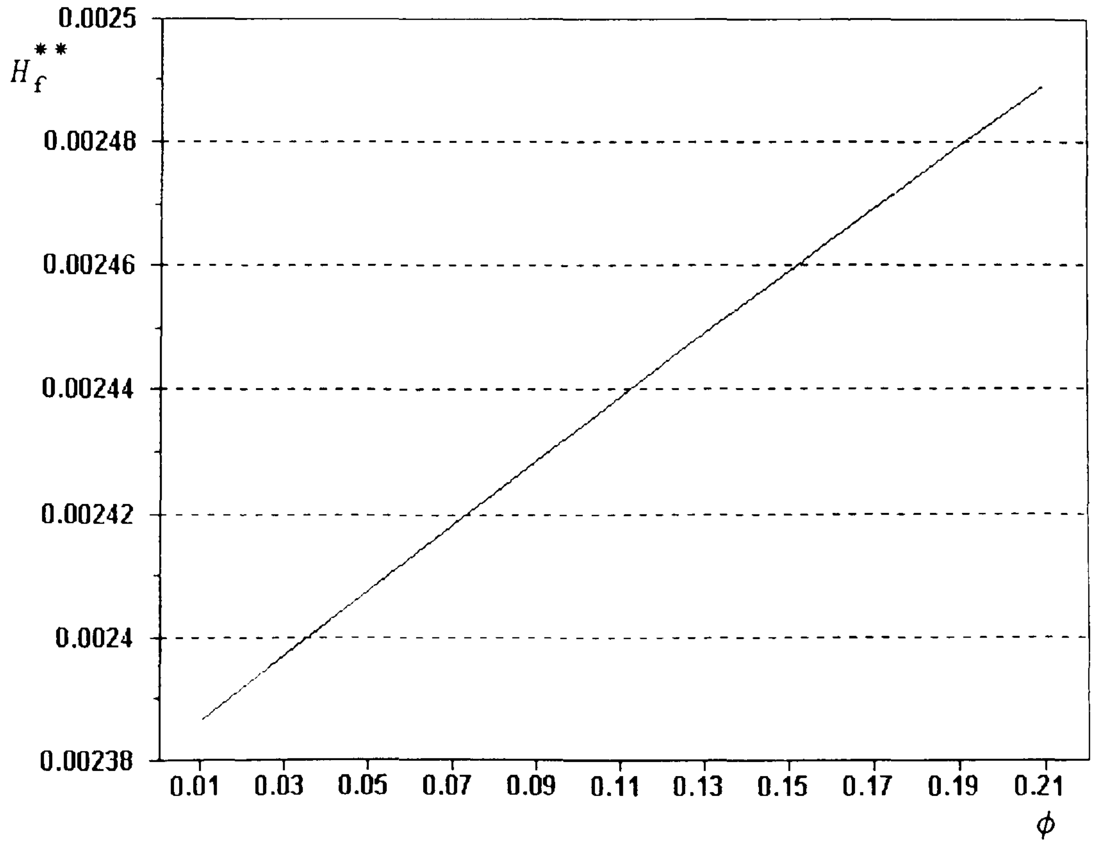

Fig. 5.9 Foreign country

Steady-state industry concentration *(δ=0.35, σ=1.7, η=1.3)*

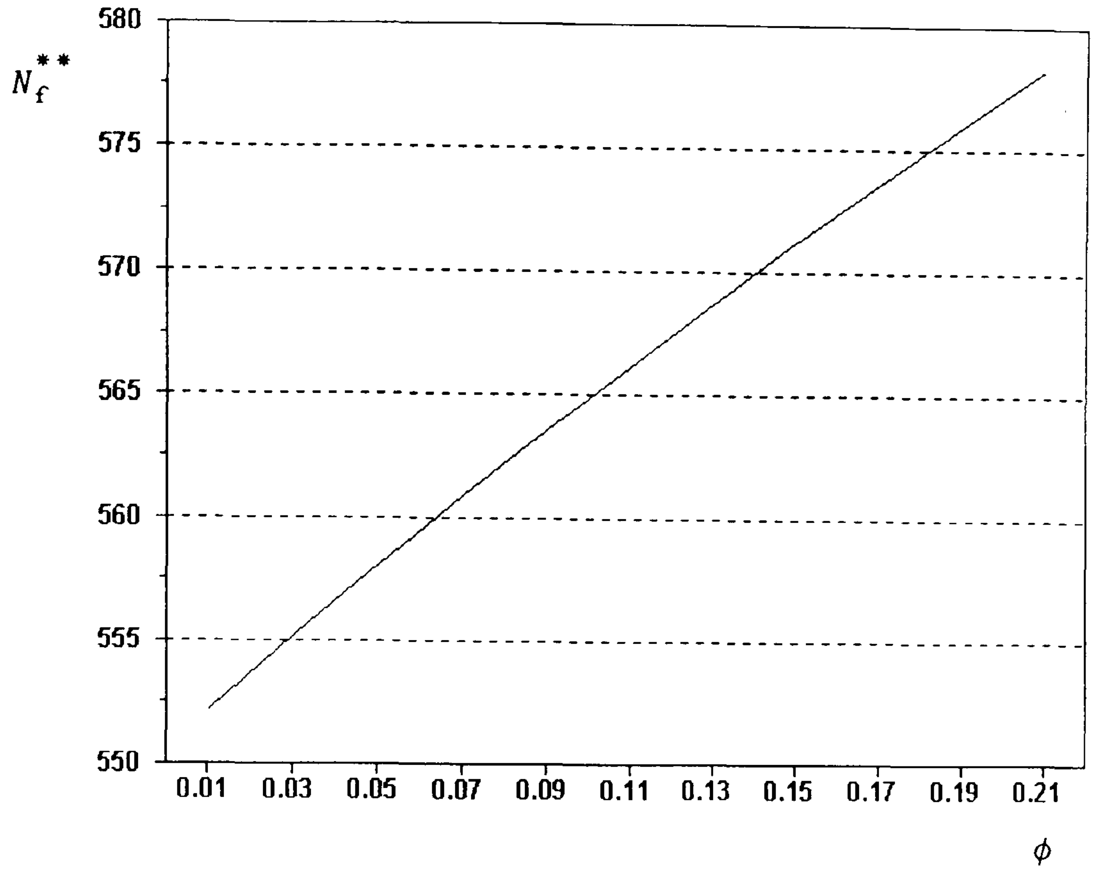

Fig. 5.10 Foreign country

Steady-state number of firms (δ=0.35, σ=1.7, η=0.9)

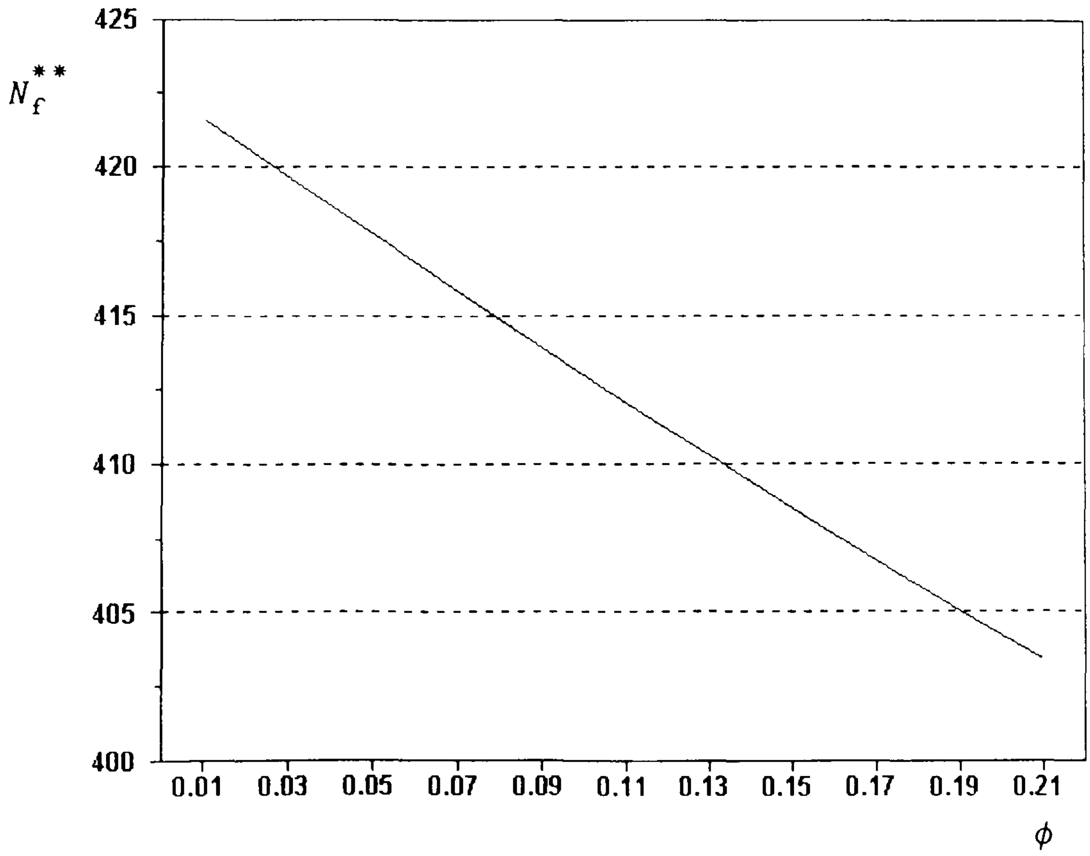

Fig. 5.11 Foreign country

Steady-state number of firms (δ=0.35, σ=1.7, η=1.3)

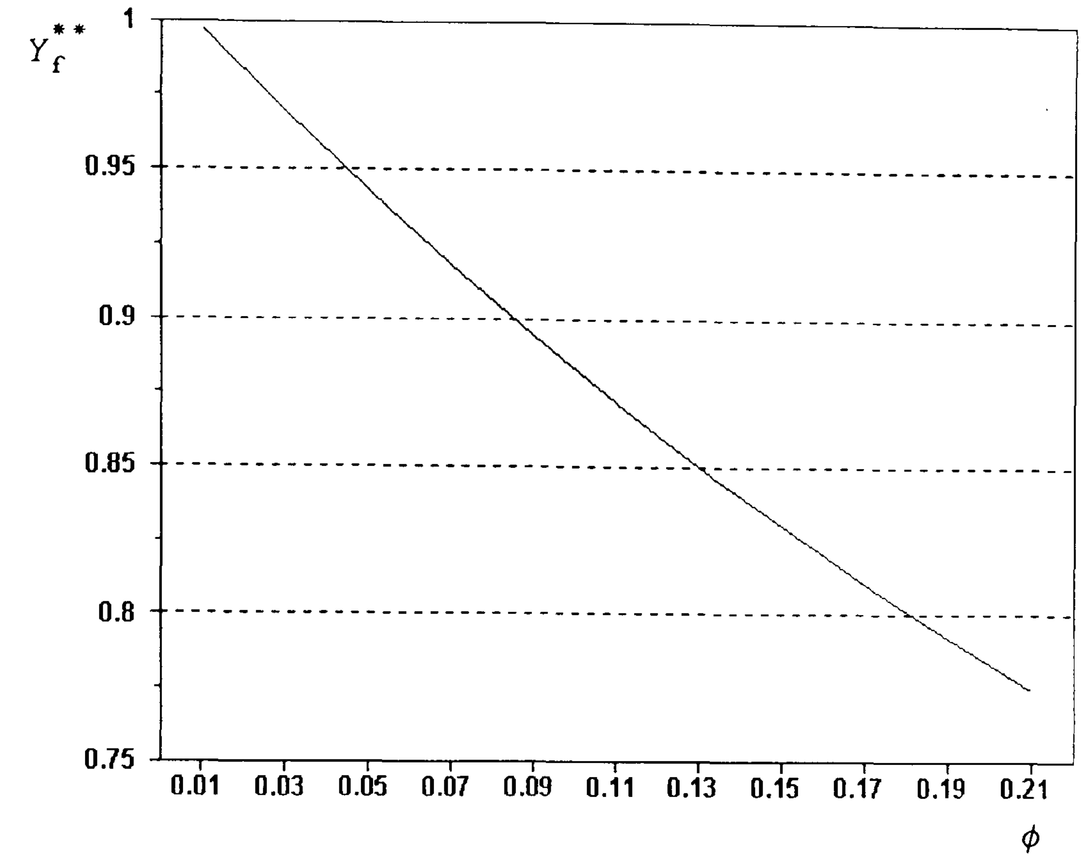

Fig. 5.12 Foreign country

Steady-state expected output *(δ=0.35, σ=1.7)*

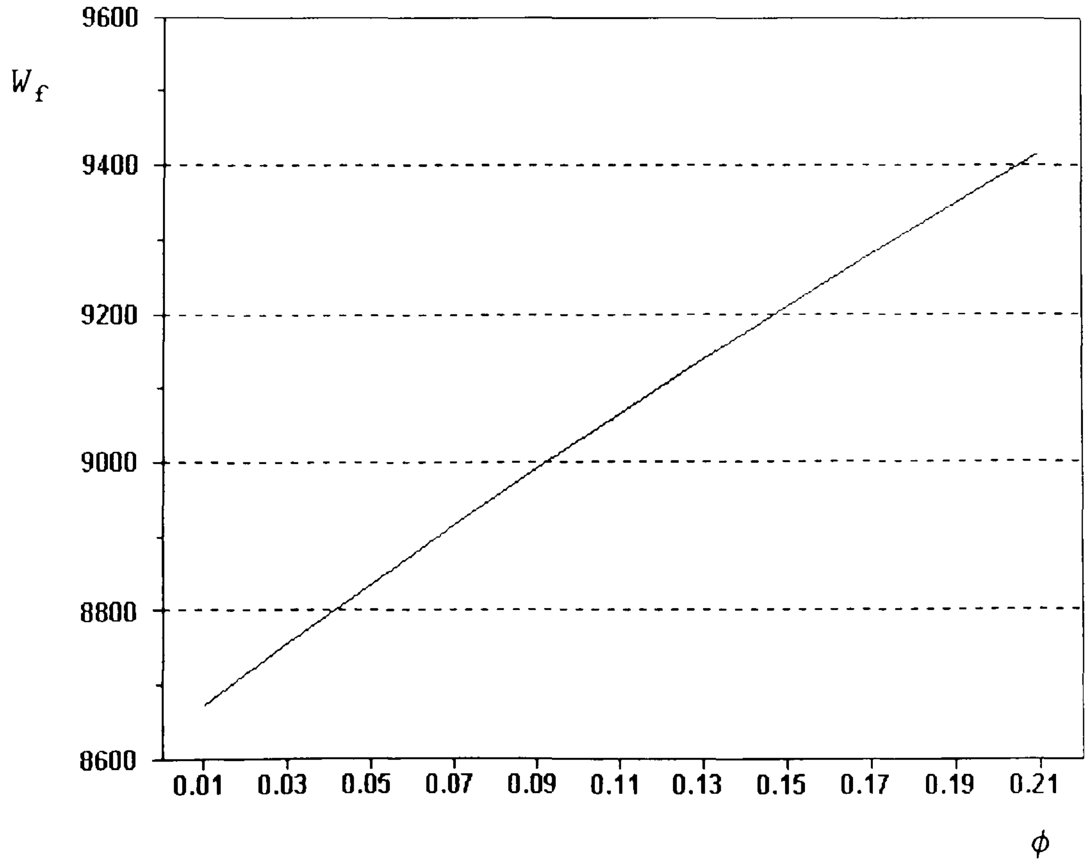

Fig. 5.13 Foreign country

Steady-state consumer welfare *(δ=0.35, σ=1.7, η=0.5)*

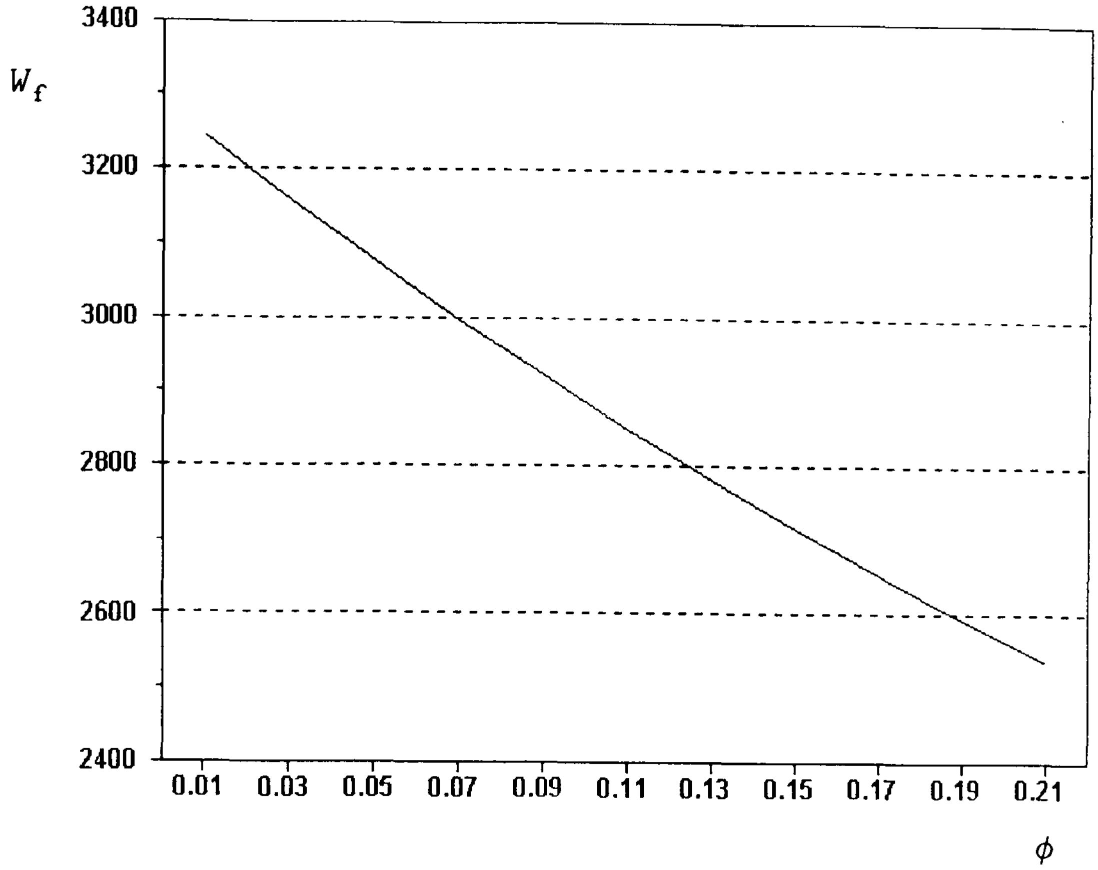

Fig. 5.14 Foreign country

Steady-state consumer welfare ($\delta=0.35$, $\sigma=1.7$, $\eta=1.1$)

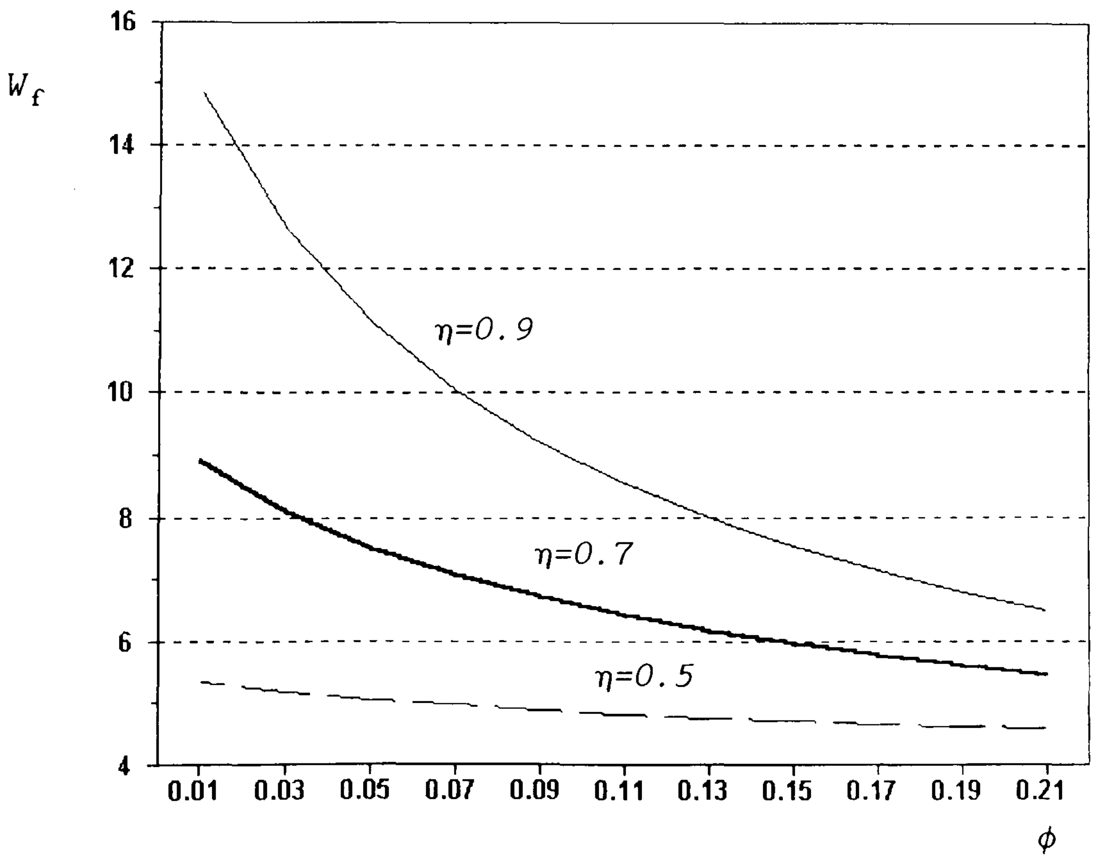

Fig. 5.15 Foreign country

Steady-state consumer welfare ($\delta=0.95$, $\sigma=4.1$)

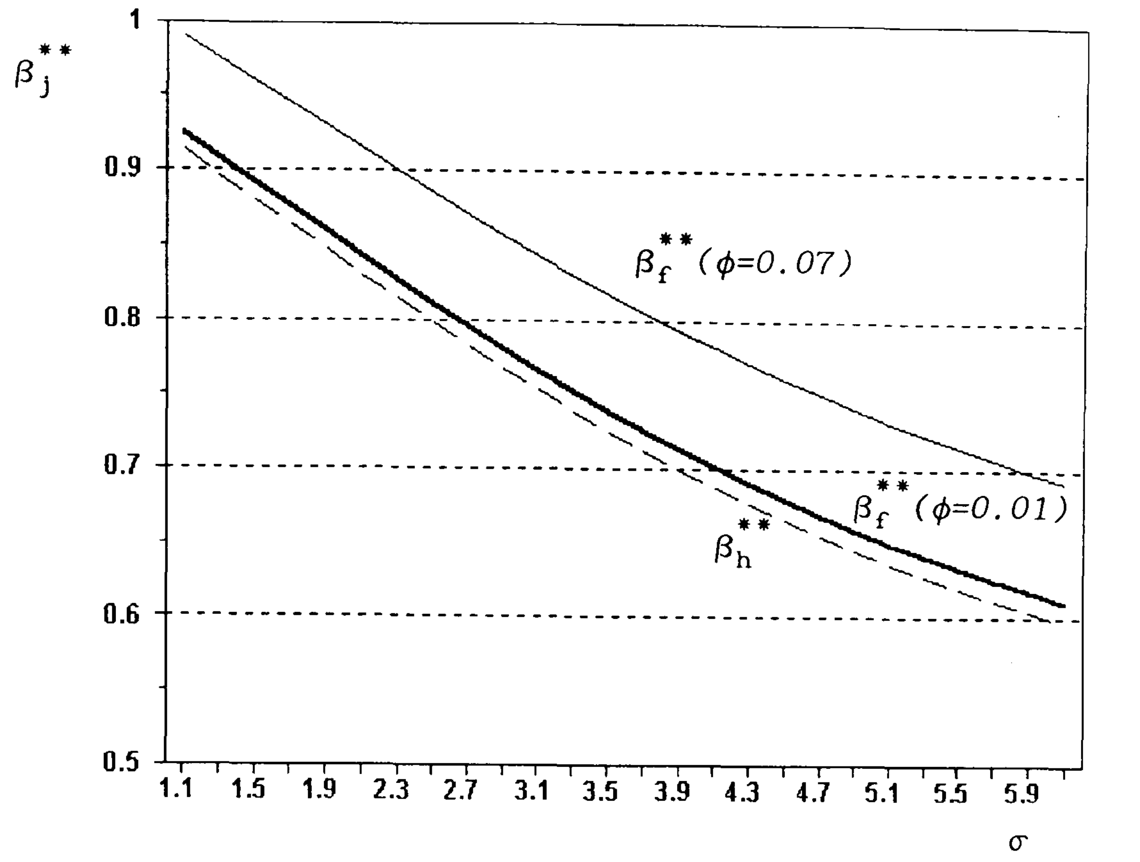

Fig. 5.16 Steady-state efficiency cut-off points

Home vs. Foreign *($\delta=0.65$)*

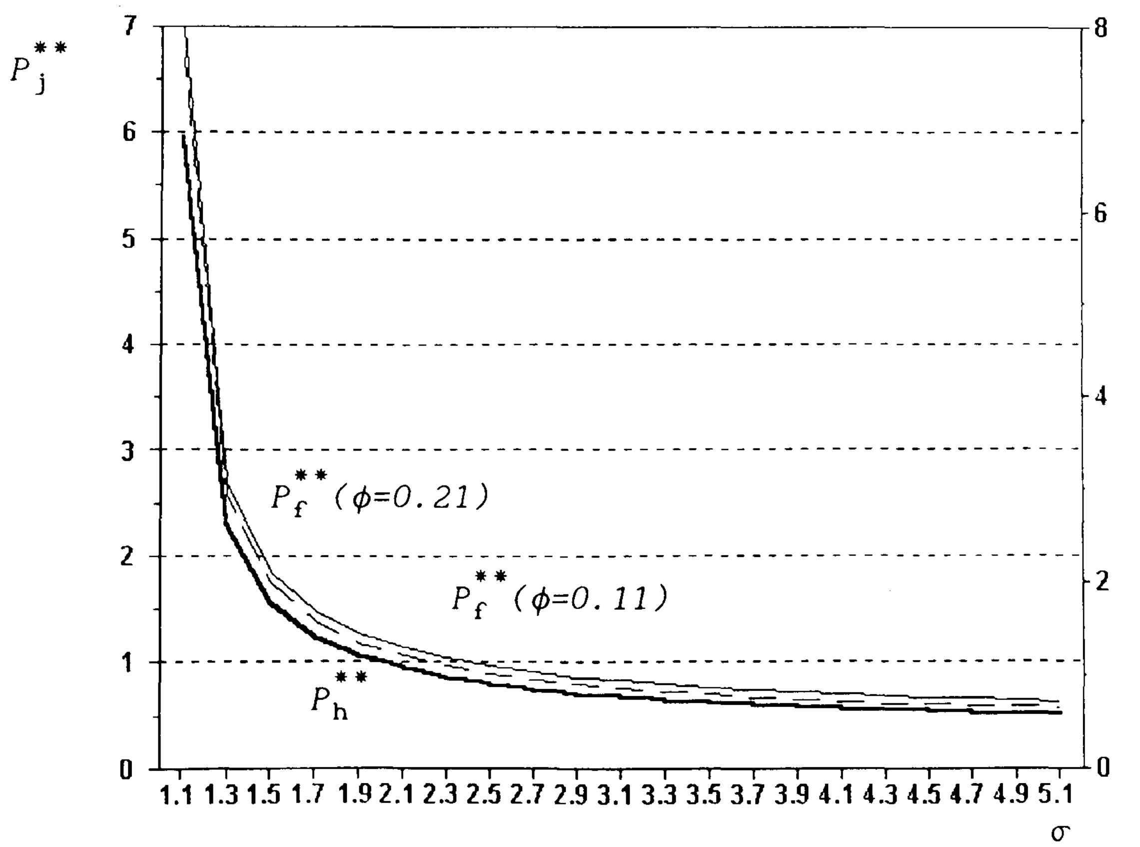

Fig. 5.17 Steady-state price index

Home vs. Foreign *($\delta=0.65$)*

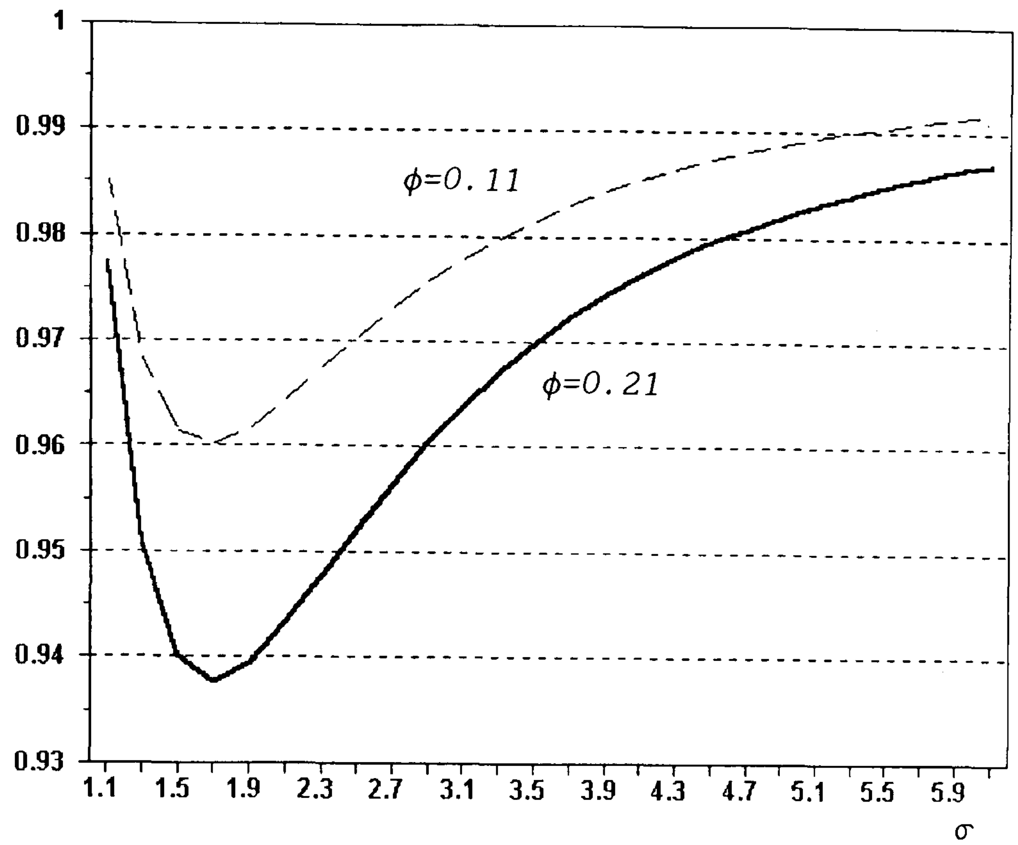

Fig. 5.18 Steady-state expected elasticity of scale Home over Foreign ($\delta=0.95$, $\eta=1$)

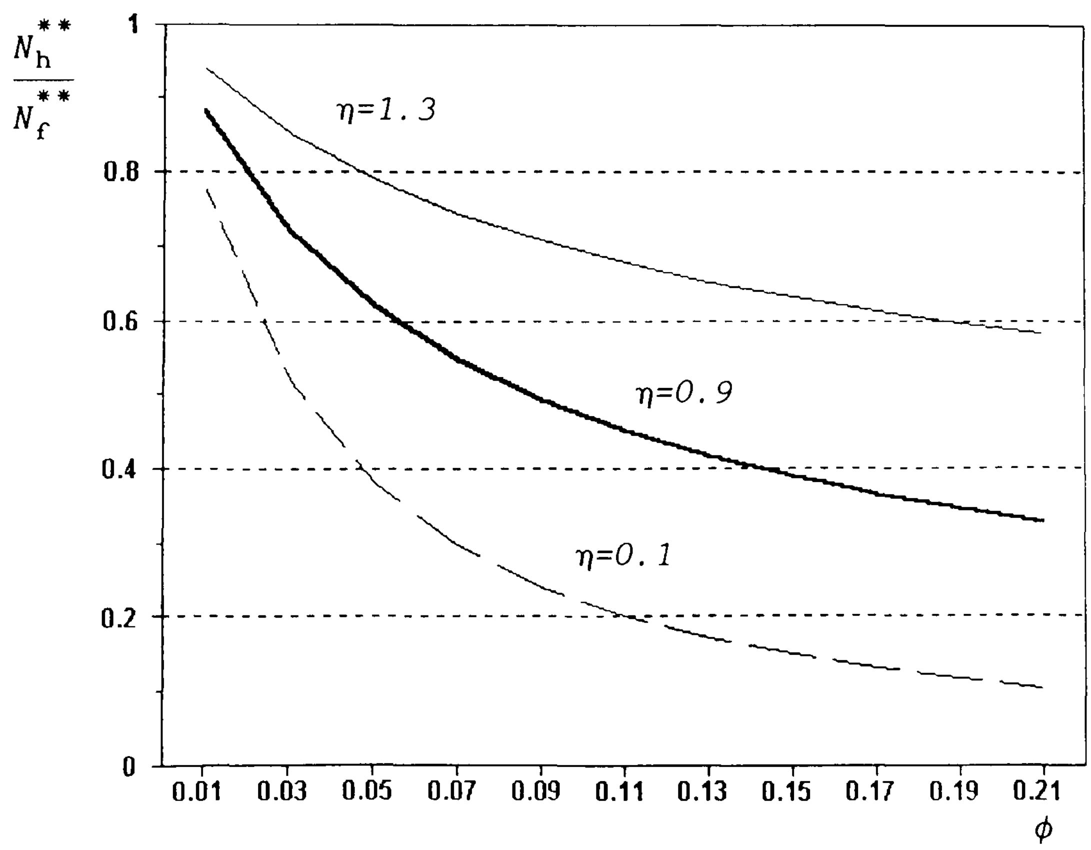

Fig. 5.19 Steady-state number of firms ($\delta=0.95$, $\sigma=4.1$)

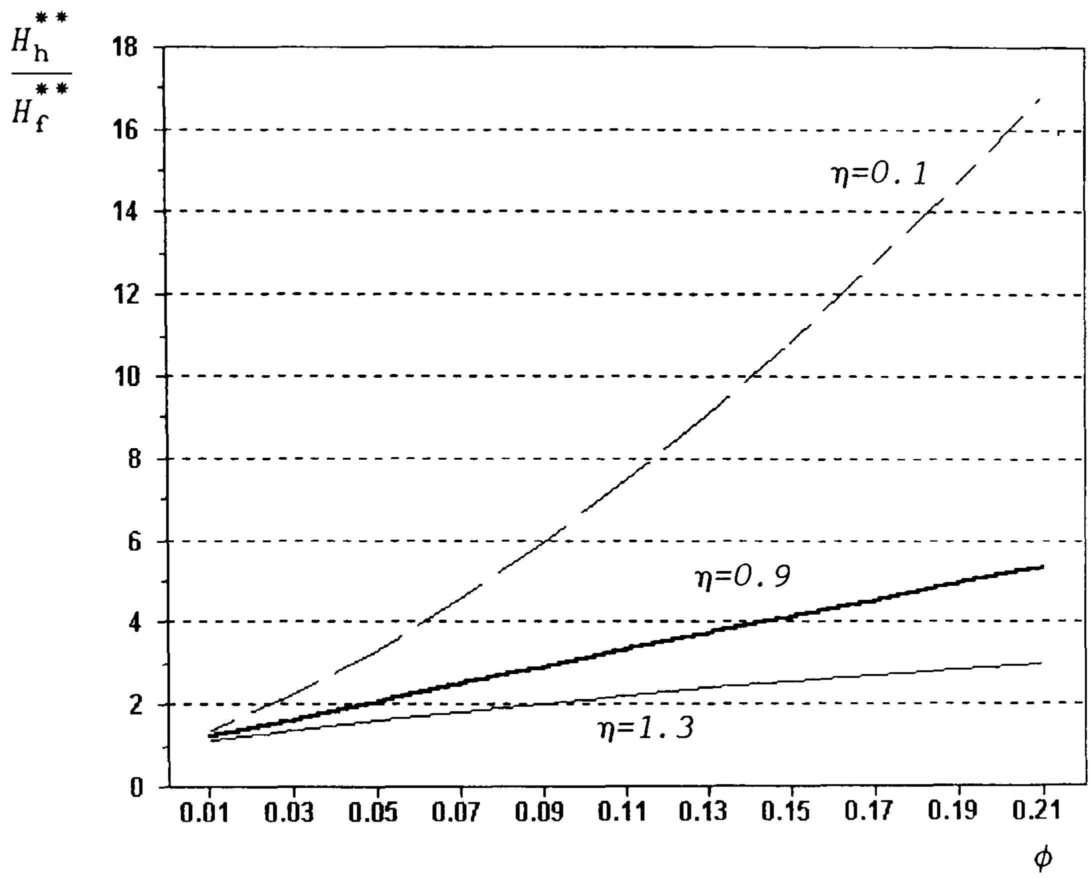

Fig. 5.20 Steady-state industry concentration

(δ=0.95, σ=4.1)

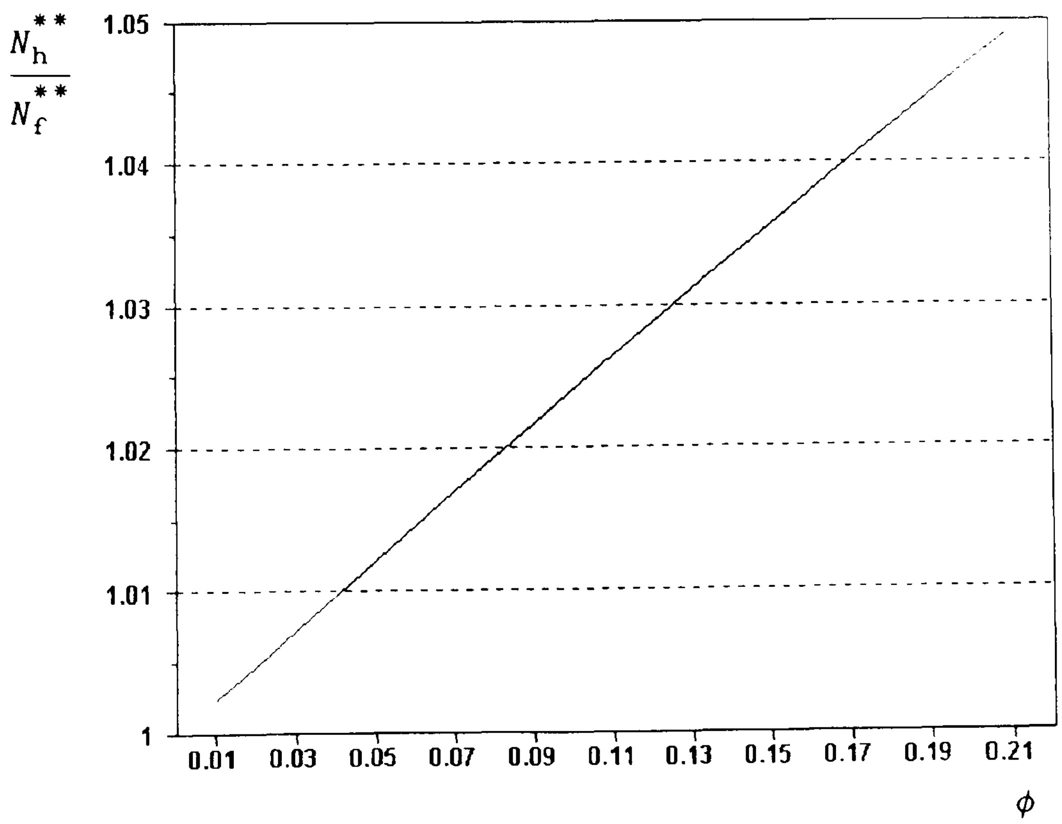

Fig. 5.21 Steady-state number of firms

(δ=0.3, σ=1.7, η=1.3)

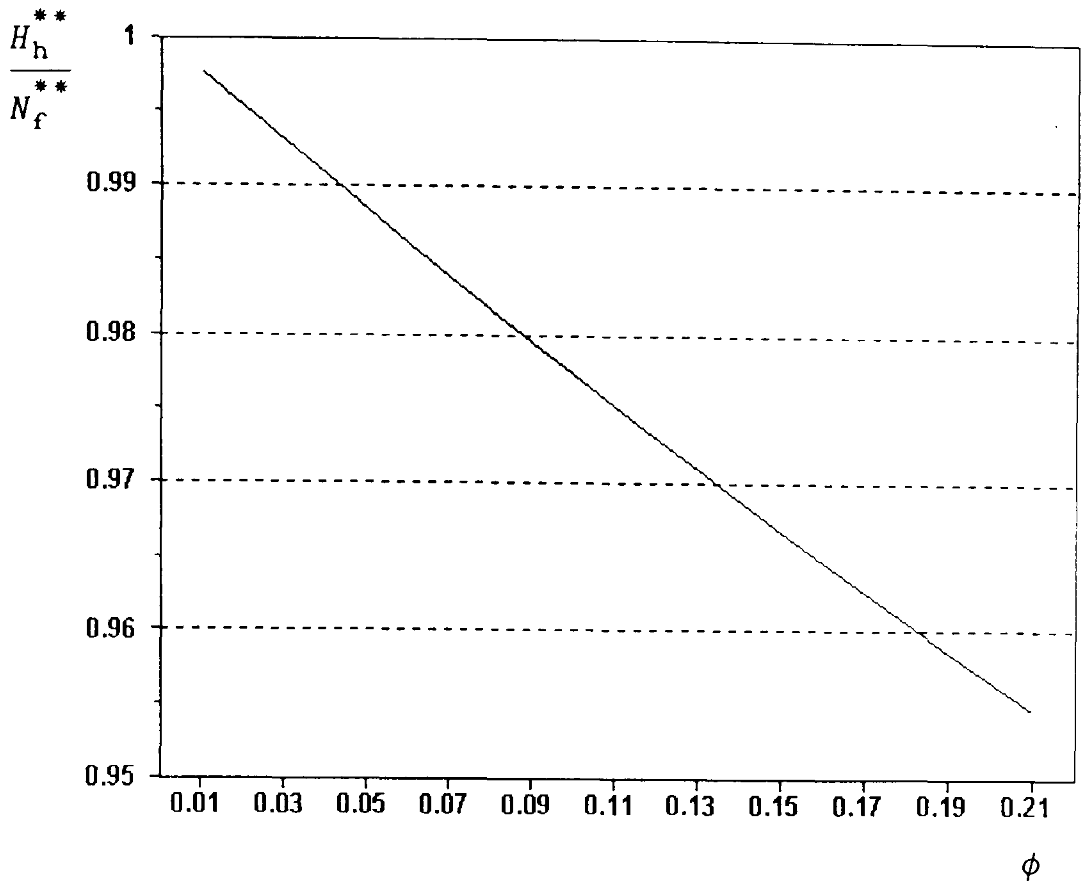

Fig. 5.22 Steady-state industry concentration

(δ=0.3, σ=1.7, η=1.3)

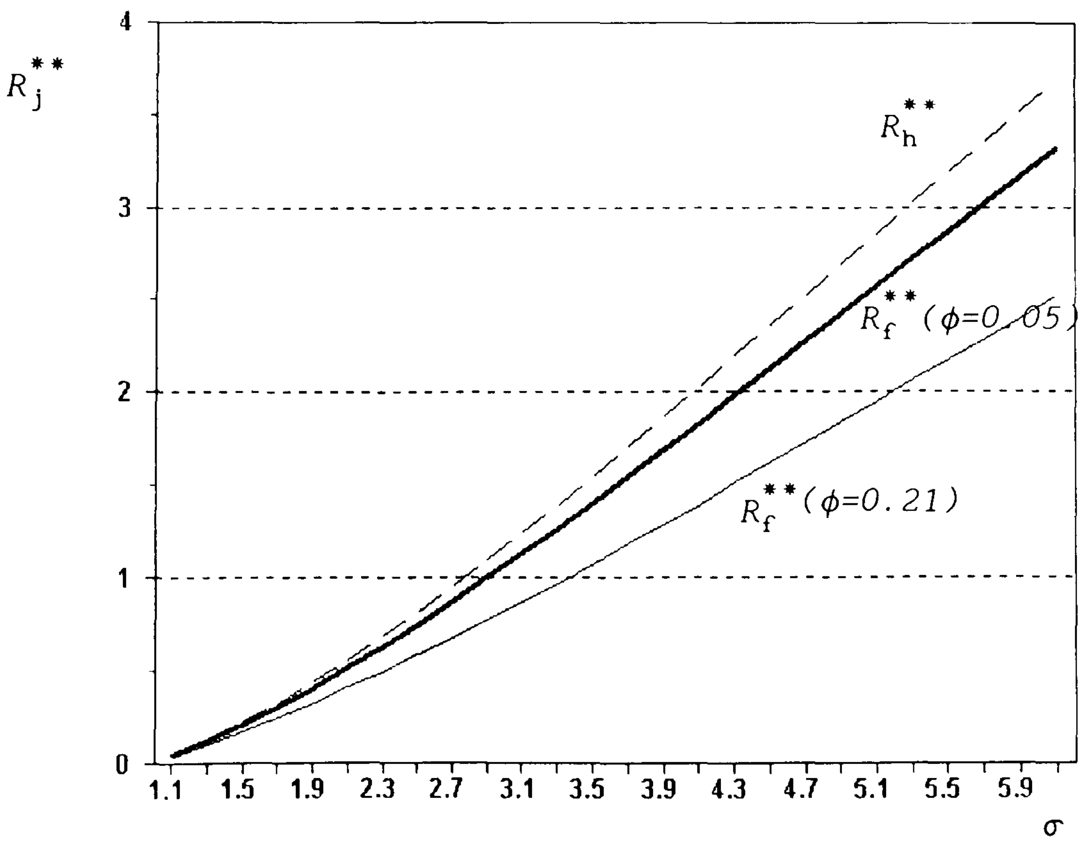

Fig. 5.23 Steady-state expected profits

Home vs. Foreign (δ=0.65, η=1)

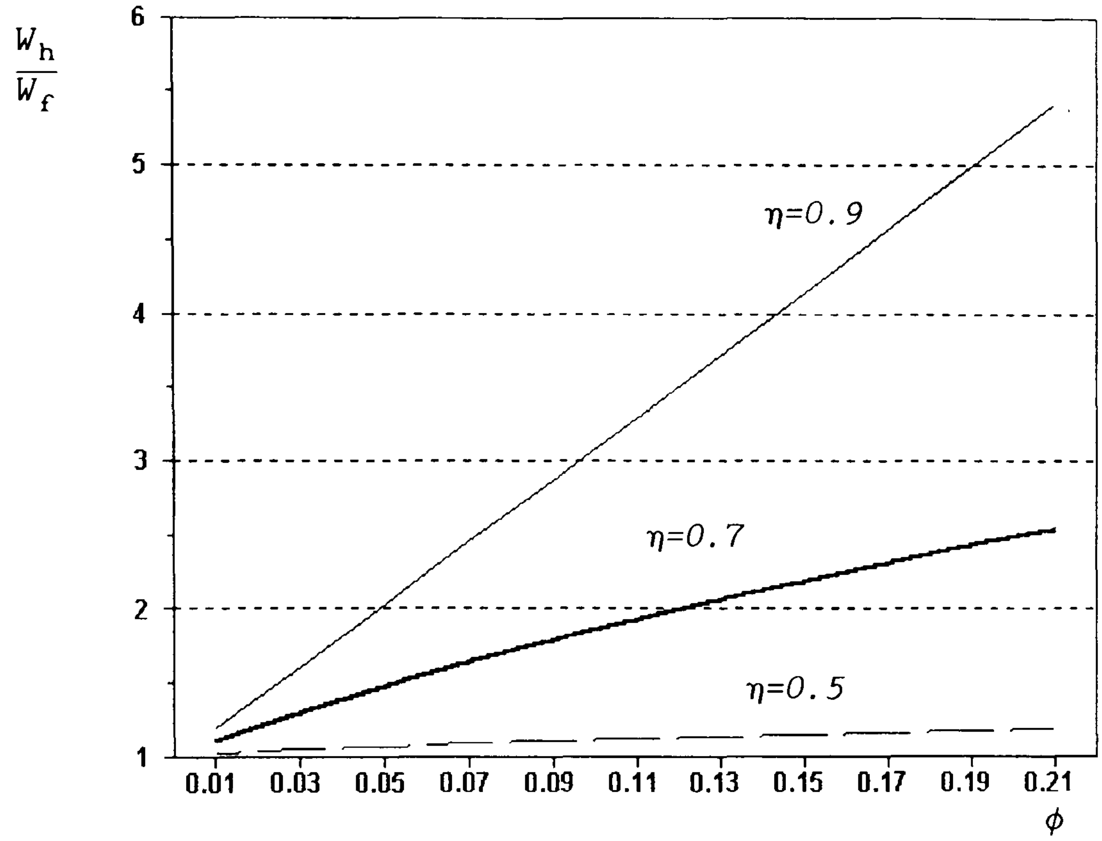

Fig. 5.24 Steady-state consumer welfare

(δ=0.95, σ=4.1)

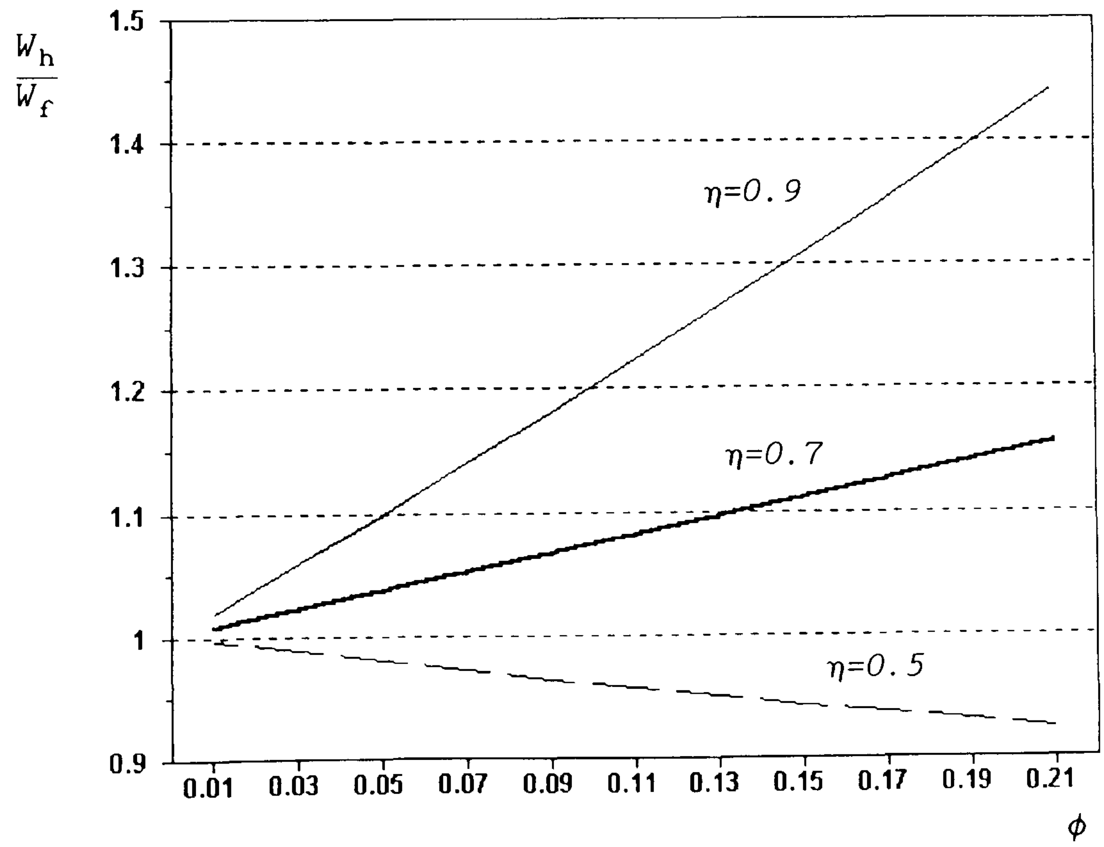

Fig. 5.25 Steady-state consumer welfare

(δ=0.3, σ=1.7)

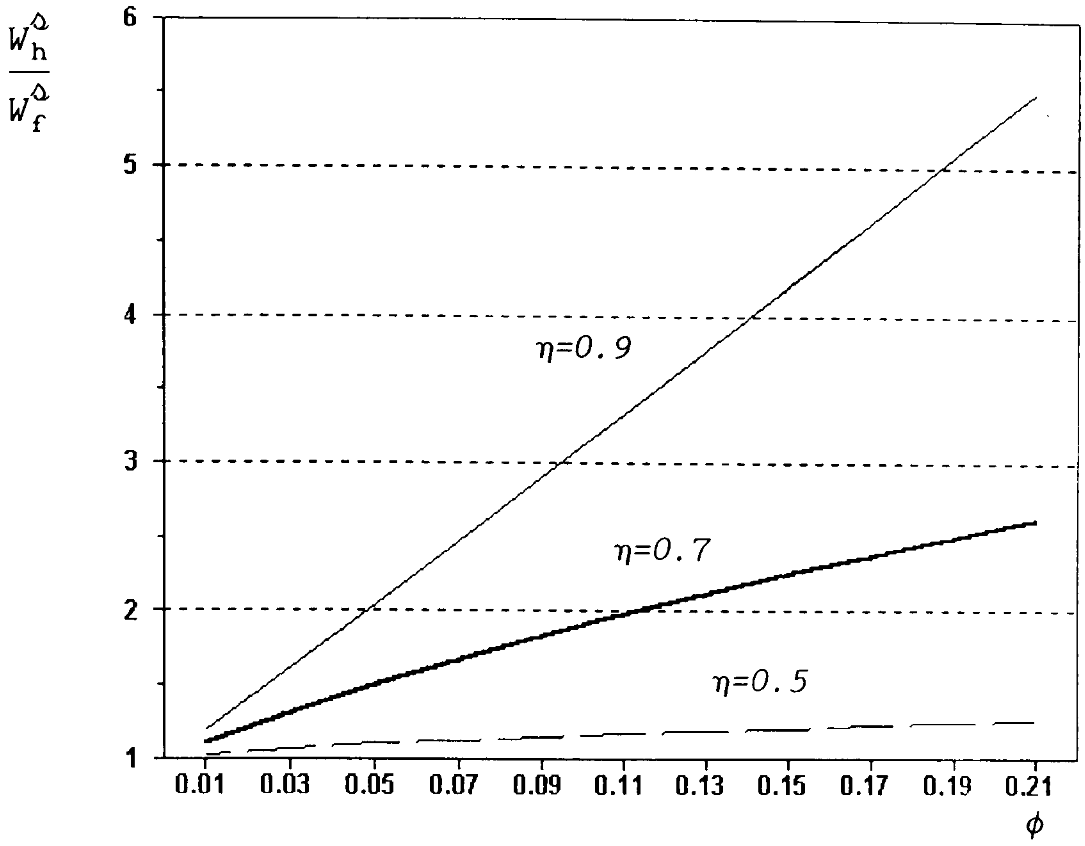

Fig. 5.26 Steady-state total industry welfare

(δ=0.95, σ=4.1)

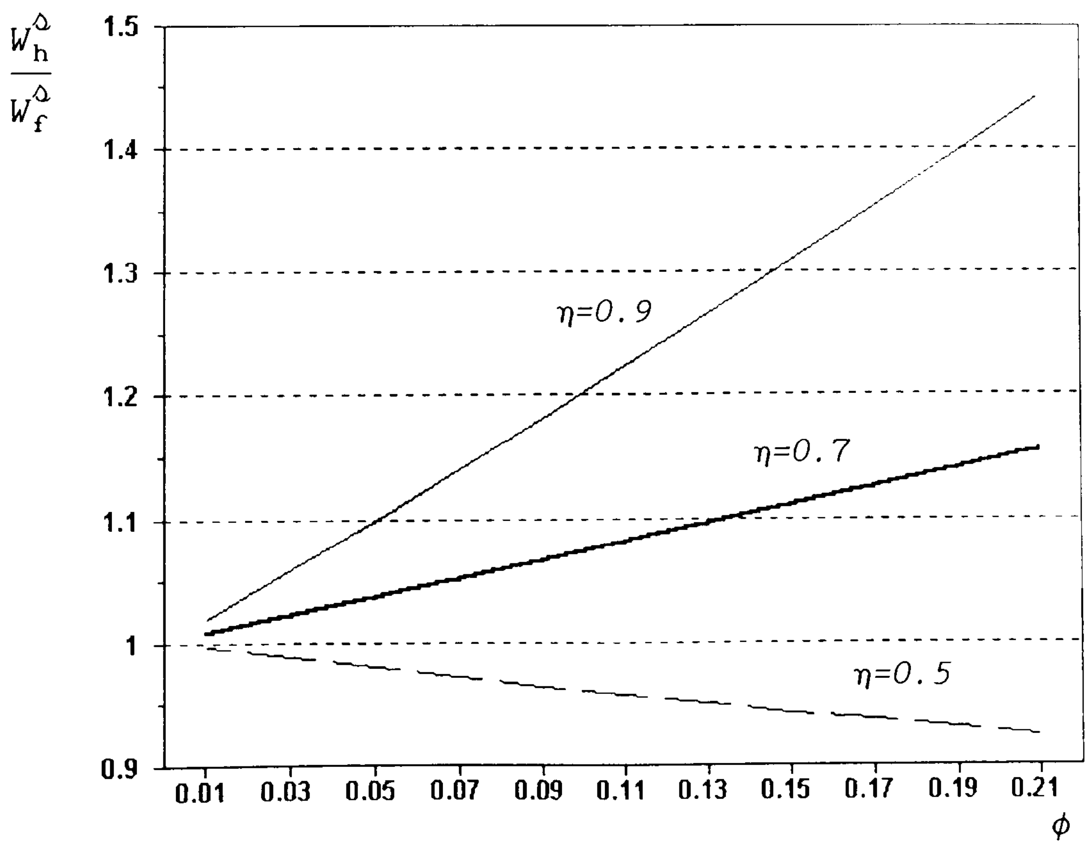

Fig. 5.27 Steady-state total industry welfare

(δ=0.35, σ=1.7)

Chapter 6

INTER-FIRM AND INTER-COUNTRY EFFICIENCY GAPS: A MONOPOLISTIC COMPETITION MODEL OF INTERNATIONAL TRADE

"Technology gaps are of paramount importance in determining the partecipation of each country in inernational trade flows."

Soete, 1990

6.1. INTRODUCTION

As highlighted in Chapter 4, recent developments in the theory of international trade have provided explanations of the patterns of international specialization alternative to those stemming from comparative advantage theories of trade, according to which countries trade in order to take advantage of their differences. Models based on imperfectly competitive market structures, utility functions that reward product diversity and increasing returns to scale technologies have established a rationale for the so called intra-industry-trade which accounts for a great deal of manufacturing trade, in particular amongst industrial economies.

In general, in these models differences across countries, albeit not denied, have a secondary role in the explanation of trade patterns. The emphasis is on the **similarity** of demand structures and production technologies. This is particularly true for models of international trade built within the monopolistically competitive framework, where these similarities are pushed to the limit by assuming fully **symmetric** economies. This simplification has two important consequences.

First, whilst imperfect competition and product differentiation explain intra-industry trade, they are not sufficient *per se* to capture the different degrees of reciprocal trade penetration which show the extent to which specialization still exists amongst industrial economies[1]. Instead, due to the assumed symmetry in technologies and demand, this standard literature predicts the free-trade market to be symmetrically shared between the trading partners. Notable exception is Krugman (1980) where the presence of transport costs ensures that firms hold different shares in their domestic and foreign markets. Venables (1987) also obtains a similar result by allowing for both the presence of transport costs and asymmetric preferences where products from different countries have different weights in consumers' utility functions[2].

Second, the symmetry hypothesis is not neutral with respect to the gains from trade. Models of monopolistic competition generally support the view that trade benefits symmetrically all partner countries. On one hand, the increased competition leads to a rationalization of the industry and generates efficiency gains. On the other hand, in an environment characterized by a taste for variety, trade increases consumer welfare *via* an increase in the

---

1 As illustrated by Porter (1990) production and export of certain categories of goods, while not totally concentrated in one country, are dominated by it.

2 In Krugman (1981) different market shares in the differentiated good market stem, within a two-sector-two-factor model, from the existence of differences in factor endowments between countries and do not result from inter-country asymmetries *within* the industry producing the differentiated good (see also Helpman and Krugman, 1985).

number of goods available for consumption.

The two country framework introduced in the previous chapter is extended here to analyze the effects of trade liberalization. Three aspects of the problem will be discussed. First, the role of technological asymmetries amongst firms and countries as a determinant of different intra-industry trade performances. Second, the way in which the introduction of such asymmetries in a monopolistic competition model affects the welfare implications of trade. Third, the effect of trade liberalization on the market structure of the two countries.

The results of this analysis differ from those of the standard monopolistic competition model of trade based on the hypothesis of homogeneous technology in two main respects. First, the integrated market is shared asymmetrically between countries, with the more efficient country supplying a bigger number, and larger quantities, of varieties than the less efficient one. Second, doubt is cast on the prediction that trade, *via* competition, leads to generalized efficiency gains (see for instance Smith and Venables, 1988). Our findings suggest that while efficiency gains at the industry level are experienced by the less efficient country, the more efficient one incurs an efficiency loss. As a result, welfare gains are not evenly spread between the two countries, and circumstances are identified where the more efficient country experiences a net welfare loss. This result is particularly striking because even when asymmetric welfare gains are found in the literature, they are generally biased in favour of the country which enjoys a cost advantage. For instance, in Venables (1987) gains from trade occur in the country experiencing cost reducing technical progress.

Finally, note that unlike models where firms do not make supernormal profits, the analysis of the welfare effects of free-trade cannot be limited here to consumers' welfare only and, given the effects of trade on industry profits, one needs to take account of producers' surplus.

6.2. THE FREE-TRADE MODEL

The two-country autarkic model developed in Chapter 5 is extended here to analyze the effects of complete trade liberalization between the two countries. Hence, free-trade is assumed to take place in a context where transport costs and all other barriers to trade are absent and consumers do not discriminate amongst goods produced in different countries as, for example, in Venables (1987, 1994).

There are mainly two effects stemming from trade liberalization. First, consumers in each country will be able to choose from the overall number of varieties produced in the integrated market. This number is denoted by $N_t=N_{th}+N_{tf}$, where the subscript t refers to free-trade and h and f as in Chapter 5 denote home and foreign countries. Second, producers will be able to sell their product in both countries, thus facing an extended market.

As before, the two countries' demand sides are assumed to be identical. Hence, in each country, the representative consumer utility function will be

$$U = \left[\sum_{i=1}^{N_t} D^{x\ (\sigma-1)/\sigma}_{tji} \right]^{\sigma/(\sigma-1)} \qquad (6.1)$$

where the superscript x $(=h,f)$ indicates the country of origin of the representative consumer and D^{x}_{tji} is the free-trade consumption of variety i produced in country j $(=h,f)$ by consumers in country x. The utility function in *(6.1)* will be maximized by each set of consumers x, subject to the budget constraint

$$P_t D = \sum_{i=1}^{N_t} P_{tji} D^{x}_{tji} \tag{6.2}$$

where P_t is the integrated market price index given by

$$P_t = \left[\frac{1}{N_t} \sum_{j} \sum_{i=1}^{N_{tj}} P_{tji}^{\,1-\sigma} \right]^{1/(1-\sigma)} \tag{6.3}$$

D is the aggregate demand on the differentiated good in country x, given as before, by $D = AP_t^{-\eta}$ and P_{tji} is the free-trade price of variety i. Note that, as in Chapter 5, we are assuming that the measure of nominal income A is the same in the two countries[3]. The solution to the above optimization problems will yield the following demand, by consumers in country x $(=h,f)$, for a variety i produced in country j

$$D^{x}_{tji} = \frac{A}{N_t} P_t^{\sigma-\eta} P_{tji}^{-\sigma} \tag{6.4}$$

Given the symmetry of their demand sides, the demand function in *(6.4)* will be identical in the two countries. However, it is obvious that equation *(6.4)* does not correspond to the demand facing each firm. Instead, the **aggregate** demand for each variety i produced in

[3] Due to the common free-trade price and the identical value of A, no country subscript characterizes D.

country j will be given by

$$D_{tji} = 2\ D^{x}_{ji}$$

$$= \frac{2A}{N_t}\ P_t^{\sigma-\eta}\ P_{tji}^{-\sigma} \tag{6.5}$$

which implies

$$D_t = D_{th} + D_{tf}$$

$$= 2\ A\ P_t^{-\eta} \tag{6.6}$$

The hypothesis that both incumbents and potential entrants form static expectations about the future state of the market is retained. As a result, the optimal price rule for firm i in country j will not be affected by trade. This can be seen by maximizing the free-trade profit function of a firm i in country j

$$\Pi_{tji} = P_{tji}\left(\frac{2A}{N_t}\ P_t^{\sigma-\eta}\ P_{tji}^{-\sigma}\right) - \beta_{ji}\left(\frac{2A}{N_t}\ P_t^{\sigma-\eta}\ P_{tji}^{-\sigma}\right) - K \tag{6.7}$$

with respect to P_{tji}. The first order condition for profit maximization will be given by $P_{tji}=\sigma(\sigma-1)^{-1}\beta_{ji}$, that is the pricing rule is the same as in autarky, *i.e.*$P_{tji}=P_{ji}$. Also, note that given the absence of any factor giving rise to market segmentation, each variety will be sold at the same price P_{tji} in both markets, regardless of where it is produced. Hence, given the optimal price, the profit of a firm i in country j is given by

$$\Pi_{tji} = \frac{2\varphi A}{N_t}\ P_t^{\sigma-\eta}\ \beta_{ji}^{1-\sigma} - K \tag{6.8}$$

where $\varphi=(\sigma-1)^{\sigma-1}\sigma^{-\sigma}$.

6.3. THE FREE-TRADE STEADY-STATE

Each incumbent will remain in the industry as long as its profit is non-negative, *i.e.* until

$$\Pi_{tji} = \frac{2\varphi A}{N_t} P_t^{\sigma-\eta} \beta_{ji}^{1-\sigma} - K \geq 0 \tag{6.9}$$

The entry process in the integrated market has been modelled to reflect two most relevant factors. First, market integration **unifies** the conditions within which countries have to operate. A firm's competitive strength is determined by its relative efficiency with respect to all firms in the integrated market and not only to the domestic ones. Within our framework, this requires a modelling strategy which can lead to the determination of a unique efficiency cut-off point, common to both countries. The second factor is related to the persistent nature of inter-firm and inter-country technical differences. Certainly, to an extent, trade flows are bound to generate knowledge spill-overs and thus to level out efficiency and - more generally - technological asymmetries between countries. However, it is a sure feature of the real world that the state of technology - where the latter is defined in a broad sense encompassing institutional, cultural and organizational aspects - remains to a great extent country-specific. Given the choice not to deal in this work with the dynamic diffusion aspects of knowledge (that in any case are not likely to eliminate inter-country differences) we adopt a modelling strategy which fully retains the country specific nature of technology. Analytically, this implies that the marginal costs distributions remain independent.

These aims are achieved by means of a number of assumptions which also ensure the determination of the number of firms operating in each country, thus allowing for the analysis of the pattern of trade. Potential entrants come from a common pool and no distinction is made amongst them with respect to their country of origin. Location, however, will not be the outcome of a rational choice, but will be seen as the product of a **historical accident** and will be assumed to be random. No relocation subsequent to entry is allowed for. After paying the fixed cost K, the entrant learns both the country where it will operate, *i.e.* the distribution from which its β is going to be drawn, and the specific value of its marginal cost.

Note that, following the recent literature on economic geography, the choice of location could have been endogenized. However, this would significantly complicate the analysis and would go beyond the aim of this paper. Two other alternatives could be considered. First, one could assume that trade "merges" the two countries' distributions into one defined over the interval $[1-\delta, 1+\phi+\delta]$. This would clearly violate the persistence of the country specific nature of technology without affecting the qualitative nature of the effects of trade on the two countries' relative efficiency[4]. A second and, given its consistency with our aims, more appealing alternative would be to assume entry to be country specific. In this case, given the partial equilibrium setting of this model, a solution could only be obtained if additional elements of asymmetry between the two countries (*e.g.* existence of transport costs, taste asymmetries, etc.) were introduced. In order to isolate

[4] This would also give rise to indeterminacy in the the number of firms operating in each country.

better the role of technical asymmetries, we have chosen to opt for the modelling strategy discussed above.

As in autarky, potential entrants from either country will attempt entry into the free-trade market as long as the expected profit from entry, given the two countries' distributions, is positive. Given the above assumptions, this condition can be defined as

$$V^E(N_t^{**}) = Prob\ (\beta_j=\beta_h)\ E(\Pi(\beta_h)) + Prob\ (\beta_j=\beta_f)\ E(\Pi(\beta_f)) > 0 \qquad (6.10)$$

Clearly, *(6.10)* implies that the two countries marginal cost distributions remain independent. Letting $Prob\ (\beta_j=\beta_h) = \rho$ and $Prob\ (\beta_j=\beta_f) = 1-\rho$, the entry condition in *(6.10)* can be rewritten as

$$V^E(N_t^{**}) = \rho \int_{1-\delta}^{1+\delta} \Pi(\beta_h)\ \frac{1}{2\delta}\ d\beta_h + (1-\rho) \int_{1+\phi-\delta}^{1+\phi+\delta} \Pi(\beta_f)\ \frac{1}{2\delta}\ d\beta_f > 0 \qquad (6.11)$$

The two components on the right-hand side of equation *(6.11)* correspond to expected profit when the entrant's β_j belongs to the home country's distribution and to the foreign one respectively.

As in autarky, we define the steady-state as the situation where market structure does not change both because no firm has incentive to attempt entry into the industry and no incumbent is forced to leave it. The free-trade equilibrium will then occur when for all potential entrants $V^E(N_t^{**}) = 0$, and for the marginal incumbents $\Pi(N_t^{**},\ \beta_t^{**}) = 0$. Hence, given the profit function in *(6.8)*, equation *(6.11)* can be set equal to zero and be solved for $N_t=N_t^{**}$ to yield the steady-state number of firms operating in the integrated free-trade market. This yields

$$N_t^{**} = \frac{\varphi A P_t^{**\sigma-\eta}}{\delta(2-\sigma)K}\left[\rho\left[(1+\delta)^{2-\sigma}-(1-\delta)^{2-\sigma}\right] + (1-\rho)\left[(1+\phi+\delta)^{2-\sigma}-(1+\phi-\delta)^{2-\sigma}\right]\right] \quad (6.12)$$

The minimum level of efficiency required to be profitable in the free-trade industry (β_t^{**}) can be obtained, given *(6.7)* and *(6.12)*, by solving $\Pi_{tji}=0$ for $\beta_{ji}=\beta_t^{**}$

$$\beta_t^{**}=\left[\frac{\rho\left[(1+\delta)^{2-\sigma}-(1-\delta)^{2-\sigma}\right]+(1-\rho)\left[(1+\phi+\delta)^{2-\sigma}-(1+\phi-\delta)^{2-\sigma}\right]}{2\delta(2-\sigma)}\right]^{\frac{1}{1-\sigma}} \quad (6.13)$$

β_t^{**} represents the marginal cost of the marginal firms in **both countries**, *i.e.* it is the common efficiency cut-off-point. Under free-trade all firms in the integrated market will face an identical efficiency requirement: trade has unified the efficiency condition for the two industries. Note that, as illustrated in Figure 6.1, other things being equal, β_t^{**} is a monotonically decreasing function of δ and σ. Hence, the behaviour of the free-trade steady-state efficiency cut-off point is consistent with that under autarky. The more different are firms and the larger is the elasticity of substitution between varieties, the tougher is price competition and the higher is the minimum efficiency required to survive in steady-state.

In the analysis that follows we assume for simplicity - without affecting the qualitative nature of the results - that $\rho=1/2$. Hence, equations *(6.12)* and *(6.13)* become

$$N_t^{**} = \frac{\varphi\ A\ P_t^{**\sigma-\eta}}{2\delta\ (2-\sigma)\ K}\left[(1+\delta)^{2-\sigma}-(1-\delta)^{2-\sigma}+(1+\phi+\delta)^{2-\sigma}-(1+\phi-\delta)^{2-\sigma}\right] \tag{6.14}$$

and

$$\beta_t^{**}=\left[\frac{\left[(1+\delta)^{2-\sigma}-(1-\delta)^{2-\sigma}\right]+\left[(1+\phi+\delta)^{2-\sigma}-(1+\phi-\delta)^{2-\sigma}\right]}{4\delta\ (2-\sigma)}\right]^{\frac{1}{1-\sigma}} \tag{6.15}$$

Finally, as shown in Appendix 6.1, from equation *(6.3)* the steady-state price index appearing will be given by[5]

$$P_t^{**} = \left[\frac{\sigma}{\sigma-1}\right]\left[\frac{2\beta_t^{**2-\sigma} - (1-\delta)^{2-\sigma} - (1+\phi-\delta)^{2-\sigma}}{(2-\sigma)\ (2\beta_t^{**}-2+2\delta-\phi)}\right]^{\frac{1}{1-\sigma}} \tag{6.16}$$

6.4. THE FREE-TRADE MARKET STRUCTURE

This section will analyze the integrated economy market structure.

6.4.1. The overall number of firms

From equation *(5.14)*, *(5.16)* - defining the autarkic steady-state number of firms - and *(6.14)* it is immediately evident that $N_t^{**}=N_{th}^{**}+N_{tf}^{**} \neq N_h^{**}+N_f^{**}$. In other words, trade does generate a change in the overall number of varieties produced in the world economy. This contrasts with the standard model *à la* Krugman where the overall number of varieties does not change when the elasticity of

---

[5] Note that the derivation of P_t^{**} in Appendix 6.I requires the determination of the steady-state number of firms within each country, which we shall illustrate in Section 6.4.

substitution between them is constant, but only when it is variable with $\sigma=\sigma(N_t)$ and $(d\sigma/dN_t)>0$. We shall shortly return to this issue.

As in autarky, for any given value of ϕ, the free-trade total number of firms (N_t^{**}) is smaller the more differentiated are their technologies and the better substitutes are the varieties they produce. The steady-state behaviour of the number of firms is analyzed by means of numerical computations which show - as illustrated in Figure 6.2 - that N_t^{**} is a decreasing function of both σ and δ. Hence, at the aggregate level, the overall market structure behaves - with respect to the parameters which we identified as determining price competition - as the two countries' autarkic market structures. From equation *(6.14)* it is also clear that even with respect to the price elasticity of demand for the overall good (η) the integrated market number of firms exhibits a comparative statics behaviour which mirrors that under autarky. Hence, $\frac{dN_t^{**}}{d\eta}\gtrless 0$ depending on whether $P_t^{**}\lesseqgtr 1$ and the effects of a change in η on aggregate demand depend on the size of the price index. Clearly, from equation *(6.6)* it follows that $\frac{dD_t}{d\eta}\begin{cases}<\\=0\\>\end{cases}$ if $P\begin{cases}>\\=1.\\<\end{cases}$ Thus, if the state of technology δ and the elasticity of substitution between varieties σ are such that the free-trade steady-state price level is smaller than one, then a *ceteris paribus* increase in the elasticity of aggregate demand with respect to price (η) will increase aggregate demand and, as a result, the integrated market will be able to sustain a larger number of firms, *i.e.* N_t^{**} will increase. The opposite will happen if the price index is larger than one. Given the relationship between β_t^{**} and δ and σ highlighted above, the larger are the latter parameters (*i.e.*

the tougher is price competition), the higher will be the integrated economy average efficiency and the lower will be the price index. As a result, the tougher is price competition the more likely $\frac{dN_t^{**}}{d\eta}>0$ will hold.

The behaviour of N_t^{**} with respect to ϕ is not monotonic. As can be seen from Figure 6.3, when the efficiency gap between countries is not very large increases in its magnitude increase the free-trade overall number of firms. When the gap is sufficiently large, however, its further increases will reduce N_t^{**}. Furthermore, note that the latter will start falling at lower values of ϕ the larger is η and the weaker is price competition. As stressed in Chapter 5, while σ and δ play a rationalizing role on industry - *i.e.* larger values of these parameters are associated with higher steady-state industry efficiency - ϕ has an opposite effect on efficiency and market structure. By reducing efficiency and increasing the level of the industry price index, a rise in ϕ will depress aggregate demand. If the latter is sufficiently price elastic and the elasticity of substitution between varieties is small enough, the effect of ϕ on market structure will dominate the rationalizing role of price competition. In these circumstances, as ϕ rises aggregate demand will not be sufficient to support an increase in the surviving number of firms.

6.4.2. Free-trade market concentration: an inter-country comparison

The two countries' free-trade number of firms are respectively given by

$$N_{th}^{**} = N_t^{**} \left(\frac{\beta_t^{**} - 1 + \delta}{2\beta_t^{**} - 2 + 2\delta - \phi} \right) \qquad (6.17)$$

and

$$N_{tf}^{**} = N_t^{**} \left(\frac{\beta_t^{**} - 1 - \phi + \delta}{2\beta_t^{**} - 2 + 2\delta - \phi} \right) \qquad (6.18)$$

where the terms in brackets give the proportions of the integrated economy overall number of types of technology in the respective country. Clearly, for any value of N_t^{**}, the number of firms in the home country is larger than in the foreign one, *i.e.* $N_{th}^{**} > N_{tf}^{**}$ holds for all values of σ, δ, η, and ϕ. Furthermore, the difference between N_{th}^{**} and N_{tf}^{**} is determined by, and positively related to, ϕ.

Taken in isolation, this result would seem to suggest that in the integrated market equilibrium the more efficient country is characterized by a lower concentration than the less efficient one. However, for a more precise picture a comparison of the two industries' Herfindhal's indexes in steady-state is required. If we define the free-trade market share (in terms of value) of a firm i in country j as $S_{tji} = \frac{P_{tji}D_{tji}}{P_t D_t}$, then free-trade size variability will be measured by $V(S_{tji}) = \int_{a_j}^{\beta_t^{**}} \left(S_{tji} - E(S_{tji}) \right)^2 g_{tj}(\beta_j) d\beta_j$, where $a_h = 1-\delta$, $a_f = 1+\phi-\delta$ and $g_{tj}(\beta_j) = 1/(\beta_t^{**} - a_j)$. Hence, the free-trade Herfindhal's concentration index for the two countries $(j=h,f)$ is given by

$$H_{tj}^{**} = N_{tj}^{**} V(S_{tj}) + \frac{1}{N_{tj}^{**}} \qquad (6.19)$$

Proposition 6.1: In the free-trade equilibrium, industry concentration is (1) higher in the more efficient country if price competition is sufficiently tough (*i.e.* σ and/or δ large) (2) higher in the less efficient country is price competition is sufficiently low (*i.e.* σ and/or δ small).

Numerical evaluation of equation *(6.19)* for the two countries shows that free-trade concentration is higher in the foreign than in the home country only for sufficiently low degrees of price competition (see Figure 6.4). It is easy to show that in each country size variability is an increasing function of both δ and σ. Clearly, this must mean that if σ and/or δ are sufficiently small the number of firms effect on the concentration index dominates the size variability effect. The opposite will happen when price competition is fierce, with the size variability effect dominating the number of firms effect. Intuitively, the tougher is price competition because, say, of a high degree of substitutability between varieties, the more strongly will demand be biased towards the more efficient firms and the more efficient country and, as a result, the more significant will be the difference between market shares held by firms with different costs. This will lead, for large δ and/or σ, to a higher concentration in the home than in the foreign country.

This analysis has interesting implications for the pattern of trade which we now turn to highlight.

6.5. TRADE PATTERN

Given the assumed demand structure, all firms in this model engage in trade, and this gives rise to intra-industry trade in the differentiated commodity. As in Krugman (1979) the direction of trade is not determined, but the volume of trade is.

However, contrary to the predictions stemming from the standard framework and due to the technical asymmetries postulated in this model, the degree of reciprocal intra-industry trade penetration is not symmetric. Instead, both the number of varieties and the output levels supplied by the two countries differ. As was shown in the previous section $N_{th}^{**}>N_{tf}^{**}$ always holds. Hence,

> **Proposition 6.2:** The more efficient country provides the world market with more varieties than its trading partner.

Furthermore,

> **Proposition 6.3:** The more efficient country provides the world market with larger quantities than its trading partner.

Proposition 6.3 can be illustrated by computing and comparing the free-trade steady-state expected size of a firm in the two countries, approximated by the expected output levels Y_j^{**} given by

$$Y_{tj}^{**} = \int_{a_j}^{\beta_t^{**}} D_{tji}(\beta_j, N_t^{**})\ g_{tj}(\beta_j)\ d\beta_j \tag{6.20}$$

where $g_{tj}(\beta_j) = 1/(\beta_t^{**}-a_j)$ and D_{tji} is given by equation *(6.5)*. This will yield

$$Y_{th}^{**} = \frac{\beta_t^{**1-\sigma} - (1-\delta)^{1-\sigma}}{(1-\sigma)(\beta_t^{**}-1+\delta)} \frac{2\varphi A}{N_t^{**}} P_t^{**\sigma-\eta} \tag{6.21}$$

and

$$Y_{tf}^{**} = \frac{\beta_t^{**1-\sigma} - (1+\phi-\delta)^{1-\sigma}}{(1-\sigma)(\beta_t^{**}-1-\phi+\delta)} \frac{2\varphi A}{N_t^{**}} P_t^{**\sigma-\eta} \tag{6.22}$$

As illustrated in Figure 6.5, it is easy to show that $(Y^{**}_{th}/Y^{**}_{tf})$ is greater than unity for all values of the relevant parameters. This can plausibly be explained by arguing that home firms, by enjoying a favourable efficiency gap, sell more - on average - than foreign ones. Furthermore, given that $N^{**}_{th}>N^{**}_{tf}$, it follows that even the total output[6] of the home country will be larger than that of the foreign one, that is $N^{**}_{th}Y^{**}_{th}>N^{**}_{tf}Y^{**}_{tf}$.

This conclusion is supported by the examination of the market share in terms of value held by each country. From the definition of market share, the overall market share of each country will be given by

$$S_{tj} = N_{tj} \int_{a_j}^{\beta^{**}_t} S_{tji}\ g_{tj}(\beta_j)\ d\beta_j \tag{6.23}$$

where $a_h=1-\delta$, $a_f=1+\phi-\delta$ and $g_{tj}(\beta_j) = 1/(\beta^{**}_t-a_j)$. Given equations *(6.5)*, *(6.6)*, *(6.17)* and *(6.18)*, this yields

$$S_{tj} = \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} P_t^{**\sigma-1}\ \frac{\beta_t^{**2-\sigma} - a_j^{2-\sigma}}{(2-\sigma)(2\beta^{**}_t-2+2\delta-\phi)} \tag{6.24}$$

Clearly, the ratio

---

[6] This measure of total output provides an estimate of the **physical** output produced by each industry and not of what in the monopolistic competition literature is referred to as the **true** or **effective** output. The latter is derived from the utility function and takes into account the value of product diversity to consumers. See for instance Krugman (1982) and Krugman and Helpman (1985).

$$\frac{S_{th}}{S_{tf}} = \frac{\beta_t^{**2-\sigma} - (1-\delta)^{2-\sigma}}{\beta_t^{**2-\sigma} - (1+\phi-\delta)^{2-\sigma}} \tag{6.25}$$

is greater than unity for all parameter values, thus indicating that the more efficient country holds a larger share of the integrated market.

Thus, the acknowledgement of the existence of efficiency differences amongst firms and between countries lead to different predictions as to the pattern of trade stemming from the monopolistic competition model, with the more efficient country holding a larger share of the integrated market. But we can go further and add that

> **Proposition 6.4:** The tougher is price competition (*i.e.* the larger is σ and/or δ) the larger will be the share of the integrated market held by the more efficient country.

Indeed, the market share bias in favour of the home country will be greater the larger are the elasticity of substitution amongst varieties and the degree of heterogeneity amongst firms. This is evident given that the larger are these parameters the larger is the gap between the countries' number of firms and their expected size.

This result is particularly relevant in this framework because it highlights the importance of the hypothesis of firms' heterogeneity for trade pattern. Clearly, for any given value of σ, the more one departs from the homogeneous firms setting, the larger will *ceteris paribus* be the degree of asymmetry in the shares of the integrated market held by the two countries.

> **Corollary 6.1:** For sufficiently tough levels of price competition, all the free-trade market is held by the more efficient country.

From equation *(6.18)* we obtain $\frac{\partial(N^{**}_{tf}/N^{**}_{t})}{\partial\sigma} = \frac{\phi(\partial\beta^{**}_{t}/\partial\sigma)}{(2\beta^{**}_{t}-2+2\delta-\phi)^2}$ which is negative given that $\partial\beta^{**}_{t}/\partial\sigma<0$. Hence - for any given δ - N^{**}_{tf}/N^{**}_{t} is monotonically decreasing in σ and becomes zero for sufficiently large values of the elasticity of substitution between varieties. The ratio N^{**}_{tf}/N^{**}_{t} is plotted against σ in Figure 6.6. This result stems from the fact that the tougher is price competition the less competitive is the foreign country as a result of its efficiency disadvantage[7]. Obviously, as can be seen from Figure 6.7, the disappearance of its industry will occur at lower levels of price competition the larger is ϕ. Clearly, this outcome will be reflected in the relative degree of concentration of the two countries. As can be seen from Figure 6.8, when price competition is **very** tough, the ratio H^{**}_{th}/H^{**}_{tf} starts falling and eventually becomes negative. Hence, when price competition is very fierce, the higher concentration of the foreign country reflects a competitive weakness and not a higher industry efficiency.

It is worth noting the potential normative implications of this outcome. If the industry is of "strategic" importance and/or is a source of positive spill-overs to other sectors of the economy, the possibility of its disappearance may justify calls for protectionist trade policies. Clearly, a proper analysis of these issues is beyond the partial equilibrium framework of this model.

[7] The reduction of the less efficient country's number of firms under free-trade to very small numbers does not affect the plausibility of the assumed conjectural variations, given that under free-trade each firms competes with all the other firms in the integrated market.

6.6. ON THE RATIONALIZING EFFECTS OF FREE-TRADE

As was discussed in Chapter 4, there is a widespread consensus on the so called rationalizing effects of free trade. In this section the implications of allowing for inter-firm and inter-country technical heterogeneity for the effects of trade on efficiency are discussed.

6.6.1. The effects of free-trade on industry efficiency

By unifying the competitive conditions in which firms from different countries operate, trade affects the competitive selection process and modifies firms' relative efficiency.

Proposition 6.5: Trade liberalization makes the efficiency requirement more stringent for the less efficient country and less severe for the more efficient one.

From equation *(6.13)* it is clear that for $\rho=1$ $\beta_t^{**}=\beta_h^{**}$ and for $\rho=0$ $\beta_t^{**}=\beta_f^{**}$. Thus, for $0<\rho<1$, $\beta_h^{**}<\beta_t^{**}<\beta_f^{**}$ holds for all values of σ, δ, and ϕ. As a result, the efficiency requirement becomes tougher for the foreign country and less severe for the home one. Hence, home firms which were not capable of surviving in autarky are sufficiently efficient under trade because they face less efficient foreign competitors. In this sense, trade can be seen as reducing the toughness of the competitive selection process for the home country and increasing it for the foreign one. Consequently, more **types** of technology survive in the home country under trade than in autarky. The opposite happens in the foreign country, where the free-trade steady-state shows a smaller number of surviving types of technology. Hence, the average industry efficiency falls in the home country and increases in the foreign one. This is clearly reflected in a higher marginal cost variability in the former than in the latter. It can therefore be concluded that whilst trade liberalization acts as a **rationalizing** force on the less efficient country's industry efficiency, it has **de-rationalizing** effects on the more efficient industry.

From equation *(6.13)* it is also easy to verify that *ceteris paribus* β_t^{**} is increasing in ϕ which means that the larger is the efficiency gap (ϕ) between the two countries the larger will be the common efficiency cut-off point (see Figure 6.9). Hence, higher values of ϕ will correspond to lower levels of average efficiency in the integrated market.

Proposition 6.6: The relative efficiency effects of free-trade are more enhanced the larger is the efficiency gap between countries (ϕ).

Clearly, the larger is the efficiency gap between countries, the lower will be the efficiency of the surviving types of technology in the foreign industry. This, in turn, implies that the larger is ϕ the lower is the **pressure to be efficient** in the home country. It also follows that *ceteris paribus* increases of ϕ will correspond to larger differences between the two countries' autarkic minimum efficiency requirements and the common free-trade one.

An important result has thus been established which casts doubt on the general validity of the widely spread belief that trade rationalizes industries *via* competition. Instead, given its opposite effects on the industry efficiency composition of the two countries industries, trade brings about efficiency gains only if a country is competing with a more efficient partner.

6.6.2. The efficiency effects of trade at the firm level

In presence of economies of scale internal to the firm, trade liberalization, by increasing the extent of the market, may result in larger scales and lower unit costs. Hence, trade acts as a rationalizing force at the firm level. In order to assess the relevance of this efficiency increasing mechanism in this model, we shall analyze the effects of the move from autarky to free-trade on the degree of scale economies. As in Chapter 5, the latter will be measured by the average cost to marginal cost ratio. Under autarky, the elasticity of scale is given by equation (5.26). The corresponding measure under trade is

$$E(\theta_{tji}) = \int_{a_j}^{\beta_t^{**}} \left[1 + \frac{K}{\beta_{ji} D_{tji}(N_t^{**})} \right] g_{tj}(\beta_j)\, d\beta_j \tag{6.26}$$

where $a_h = 1-\delta$, $a_f = 1+\phi-\delta$, $g_{tj}(\beta_j) = 1/(\beta_t^{**} - a_j)$ and D_{tji} is given by equation *(6.5)*.

The ratio $E(\theta_{ji})/E(\theta_{tji})$, $j=h,f$, has been numerically evaluated within the usual parameter intervals.

> **Proposition 6.7:** Trade liberalization increases the expected degree of exploitation of internal economies of scale in the more efficient country and reduces it in the less efficient one.

As illustrated in Figure 6.10, our results show that for all values of the relevant parameters, $E(\theta_{hi}) > E(\theta_{thi})$ and $E(\theta_{fi}) < E(\theta_{tfi})$. Thus, trade reduces the expected degree of exploitation of potential economies of scale in the less efficient country and increases it in the more efficient one[8]. The rationale of this result is that - due to its efficiency advantage - the more efficient country holds a larger share of the integrated market and thus benefits relatively more from the increase in the extent of the market brought about by trade.

6.6.3. Summary on the efficiency effects of trade

The analysis carried out in this section shows trade liberalization to affect efficiency on two levels.

First, by unifying the efficiency conditions within which firms operate, trade affects the competitive selection process in the two countries. At the **industry level**, the competitive pressure falls in the more efficient country and increases in the less efficient one. As a result, some types of technology which would not have been competitively successful under autarky manage to survive under trade in the country which enjoys a favourable efficiency gap. The opposite will happen in its less efficient trading partner, where a smaller number of types of technologies survive under trade. Note that this efficiency effect of trade is not present in the standard monopolistic competition literature where, due to the assumed technical homogeneity between firms, competitive selection processes are absent.

Second, trade has an effect on the degree of exploitation of potential economies of scale at the **firm level**. The expected scale of

[8] It can be proved that - as in autarky - even under free-trade the degree exploitation of scale economies is always higher in the home than in the foreign country.

production increases in the more efficient country and falls in the less efficient one, reflecting the fact that the former - due to its efficiency advantage - benefits more than the latter from the increase in the size of the market associated with trade liberalization.

The role of trade in changing output scales when production processes exhibit increasing returns to scale internal to the firm is typically acknowledged in the monopolistic competition literature. Note, however, that in the standard model *à la* Krugman trade affects the degree of scale economies only in the variable elasticity of substitution case. When the elasticity of substitution between varieties is constant, trade has no effect on the scale of production. However, in this model - due to the assumed inter-firm and inter-country technical asymmetries - trade affects efficiency within the firm even in the constant elasticity of substitution case. It is important to stress that in the two models the scale effect of trade is different in nature. In the standard variable elasticity of substitution case, trade affects the degree of exploitation of scale economies as a result of its effect on σ. The increase in the latter, stemming from the larger number of varieties brought about by trade, reduces firms' monopoly power, induces exit and leads to a steady-state characterized by a smaller number of firms which operate on a larger scale. In the model developed here, the crucial factor is the **persistence** of the inter-country efficiency gap. Despite the fact that by changing the toughness of the competitive selection process trade modifies the structure of efficiencies in the two countries, the persistent efficiency differential characterizing the two marginal cost distributions allows the home country to take better advantage of the increase in the extent of the market brought about by trade. This result accounts for the change in the overall number of varieties produced in the world economy which was highlighted in Sub-section 6.4.1. However, due to the different nature of the forces at work in the two models, here the relationship between change in the scale of production and number of firms differs from that emerging from the variable elasticity of substitution case analyzed by Krugman. These issues are analyzed in the next section.

6.7. THE EFFECTS OF TRADE ON THE AUTARKIC MARKET STRUCTURES

The aim of this section is to further extend the analysis of the effects of trade to encompass its implications for the steady-state market structure of the two trading partners. This entails tying up together the results obtained in the inter-country autarkic comparison of Chapter 5 with the steady-state analysis of the trade model carried out in this chapter. More specifically, we shall compare the free-trade steady-state of the two countries to their autarkic ones.

6.7.1. The effect of trade on the number of firms

Trade changes the number of varieties produced within each country. In particular:

Proposition 6.8: Trade increases the number of firms in the more efficient country and reduces it in the less efficient one.

Numerical evaluation of the ratio $\dfrac{N_j^{**}}{N_{tj}^{**}}$ shows that for all values of the relevant parameters $N_h^{**}<N_{th}^{**}$ and $N_f^{**}>N_{tf}^{**}$ always hold. For an illustration see Figures 6.11 and 6.12. Hence, in the more efficient country not only is the number of types of technology surviving under trade larger than under autarky, but the number of firms is also larger than before trade liberalization. The opposite happens in the less efficient country which experiences a decline in both the number of types of technology and in the number of firms.

Given the behaviour of the number of firms in the two countries as trade is opened up between them, it is clear that this model has substantially different implications from the standard one. Contrary to the constant elasticity of substitution version of the monopolistic competition model, the number of firms in each industry changes as a result of trade. However, this change is not consistent with that occurring in the variable elasticity case. In the latter, in both countries the number of firms falls and the scale of production increases as a result of trade. In this model, the expected degree of exploitation of economies of scale is positively related to the number of firms within each country: a larger (smaller) number of firms producing at a larger (smaller) scale operate in the more (less) efficient country. Clearly, the different predictions of the two models stem from the diverse nature of the mechanisms leading to the change in the scale of production discussed in the previous section.

To summarize, in the more efficient country trade reduces the steady-state industry efficiency. By competing with a less efficient trading partner, the efficiency requirement on domestic firms becomes less stringent and this is reflected in $\beta_t^{**}>\beta_h^{**}$. As a result, the number of firms increases with trade. However, despite the survival of less efficient types of technology which were not sufficiently competitive in autarky, the efficiency advantage of the country implies that its firms manage to exploit the increase in market size brought about by trade better than their foreign rivals. It follows that their expected scale of production increases: a larger number of - on average - larger firms survives in the home country as a result of trade liberalization. In the less efficient country, trade improves average industry efficiency given that $\beta_t^{**} < \beta_f^{**}$. As a result, the number of surviving firms falls. However, the persistence of the efficiency disadvantage implies that the expected elasticity of scale of its firms increases, thus indicating a lower exploitation of economies of scale at the firm level. Hence, trade leads to a smaller number of firms producing at a smaller scale, despite the increased toughness of the process of competitive selection which has rationalized the industry in terms of types of technology.

6.7.2. The effects of trade on concentration

For a full assessment of the effects of trade on market structure, the analysis cannot be limited to the evolution of the number of firms as the economy moves from an autarkic to a free-trade situation. To this end, we compare the Herfindhal's concentration index under autarky (equation *3.40*) to that under trade (equation *6.19*). The results of numerical evaluation of the ratio $\dfrac{H_j^{**}}{H_{tj}^{**}}$ are summarized in the following proposition.

Proposition 6.9: Trade liberalization (1) reduces concentration in the more efficient country except when, for sufficiently small values of ϕ, price competition is tough and the elasticity of aggregate demand is sufficiently large, and (2) increases concentration in the less efficient country.

Obviously, given that $N_h^{**} < N_{th}^{**}$ always holds, the non-homogeneous behaviour of the home country's concentration with respect to the structural parameters of the model must be accounted for by that of size variability. It can be shown that the variance of firms' market shares is generally larger in autarky than under free-trade, consistently with the general fall in concentration following trade liberalization. However, when price competition is sufficiently tough, the price elasticity of aggregate demand is sufficiently large and the efficiency gap is sufficiently small, size variability dominates the number of firms in determining the increase in the degree of concentration. Point (1) of the proposition is illustrated in Figures 6.13 and 6.14.

Despite the worsening of the efficiency composition of the home country's population of firms, the industry's favourable efficiency gap is such that domestic firms are better at coping with a high price competition than foreign ones. Thus, two contrasting forces are at play. The first, leading towards a lower concentration, stems from the lower efficiency at the industry level and results in an increase in the number of firms. The second stems from the persistence of the efficiency advantage the country enjoys and results in a bias in favour of home country' varieties - and within the country towards the more efficient firms. Clearly, if the price factor is very important (*i.e.* price competition is very tough) this bias may be very large and will more than compensate the negative effects on concentration of the increase in the number of firms. On the contrary, when price competition is not very fierce, the de-rationalizing effects on industry resulting from trading with a relatively less efficient country will lead to a reduction in concentration. Finally, note that a higher free-trade concentration only occurs for relatively small values of the efficiency gap. Recall that as ϕ increases the overall integrated market efficiency falls. Consequently, the larger is ϕ the larger will be the efficiency loss experienced by the home country. Hence, for sufficiently large values of ϕ the more efficient industry's relative advantage does not translate into an increase of concentration.

In the less efficient country, the rationalizing effects of trade at the industry level generate an increase in concentration (see Figure 6.15 for an illustration). This also happens in those circumstances where the latter increases in the more efficient country as well. Recall, however, that the home country's industry becomes more concentrated when price competition is very tough, that is when the foreign country's share of the integrated market is very small. Hence, in the less efficient industry the number of firms effect dominates the size effect in determining the behaviour of concentration as the foreign country opens up trade with a more efficient partner.

6.8. THE EFFECTS OF TRADE ON INDUSTRY PROFITABILITY

Most of the recent developments in the theory of industrial organization which have recognized the effects of foreign trade on industry profitability leads one to expect trade liberalization to have a negative impact on profitability. In general, this is explained with reference to the role of foreign competition in restraining the market power of domestic firms.

In this model we have found that in autarky there is a positive relationship between concentration and profitability. Furthermore, we found that trade increases industry concentration in the less efficient country and, in general, reduces it in the more efficient one. This would generate the expectation of an increase (fall) in industry profitability in the less (more) efficient country.

The expected profit under free-trade of a surviving firm is given by

$$R_{tj}^{**} = \int_{a_j}^{\beta_t^{**}} \Pi(\beta_j, N_t^{**})\, g_{tj}(\beta_j)\, d\beta_j \tag{6.27}$$

where $a_h = 1-\delta$, $a_f = 1+\phi-\delta$, $g_{tj}(\beta_j) = 1/(\beta_t^{**} - a_j)$. Equation *(6.27)* yields

$$R_{th}^{**} = K\left(\frac{4\delta\ (\beta_t^{**2-\sigma} - (1-\delta)^{2-\sigma}}{(\beta_t^{**} - 1+\delta)\big((1+\delta)^{2-\sigma} - (1-\delta)^{2-\sigma} + (1+\phi+\delta)^{2-\sigma} - (1+\phi-\delta)^{2-\sigma}\big)} - 1\right) \tag{6.28}$$

and

$$R_{tf}^{**} = K\left(\frac{4\delta\ (\beta_t^{**2-\sigma} - (1+\phi-\delta)^{2-\sigma}}{(\beta_t^{**} - 1-\phi+\delta)\big((1+\delta)^{2-\sigma} - (1-\delta)^{2-\sigma} + (1+\phi+\delta)^{2-\sigma} - (1+\phi-\delta)^{2-\sigma}\big)} - 1\right) \tag{6.29}$$

Proposition 6.10: Trade liberalization changes the relationship between concentration and profitability.

The comparison between the autarkic and free-trade expected profits indicates that the latter increase in the home country and fall in the foreign one. The ratios (R_j^{**}/R_{tj}^{**}) are plotted in Figures 6.16 and 6.17[9].

Thus, because of trade, the relationship between average industry efficiency and profitability is not consistent with the autarkic case. Despite its efficiency loss at the industry level, the home country experiences a higher profitability; instead, the industry rationalization undergone by the foreign country is accompanied by a reduction of expected profitability. Once again the rationale for this result can be found in the persistence of the efficiency gap between countries, whereby the home country competes with a trading partner which is still characterized by an efficiency disadvantage. As a result, the former benefits more than the latter from the increased size of the market which leads to a better exploitation of internal economies of scale by its firms. Furthermore, the lower (higher) competitive pressure on home (foreign) firms resulting from competition with a less (more) efficient partner, implies that the expected downward (upward) move along the average cost curve will be translated into expected higher profits. In other words, in this model the efficiency effect of trade at the firm level leads to an increase (fall) of monopoly power for the more (less) efficient countries' producers.

[9] These results are confirmed by the behaviour of the expected profit margins. By computing, from equation *(3.41)*, the expected autarkic profit margins for the two countries and comparing them to their respective values under trade it is easy to show that the expect price-cost margin increases for the more efficient country and falls for the less efficient one as a result of trade liberalization.

6.9. WELFARE EFFECTS OF FREE-TRADE

In the standard monopolistic competition literature firms' technical homogeneity, together with the imposition of the zero profit condition, generates the elimination of supernormal profits for all firms. Thus, the analysis of the effects of trade liberalization can be exhausted by examining consumer welfare. However, as was discussed in Chapter 3, in this work the existence of technical heterogeneity between firms implies that the steady-state is characterized by a **spectrum** of profits. Given the results on the effects of trade on market structure it is likely that these profits are affected by trade. It is therefore necessary to analyze the impact of trade on both consumer and producer welfare.

The following analysis is based on that carried out in the previous chapters. Hence, the indirect utility function is used as a measure of consumer welfare. Producer surplus will instead be approximated by the total industry profit in steady-state.

6.9.1. Consumer welfare

Before analyzing the indirect utility function, it is worth distinguishing between the two main factors through which trade affects consumer welfare in this model. These are the number of varieties of the differentiated good available for consumption and the average price level.

6.9.1.1. The variety effect

Trade definitely increases the number of varieties available for consumption, given that $N_t^{**} > N_j^{**}$.

Proposition 6.11: By increasing the number of varieties available for consumption trade has a positive effects on consumer welfare.

Hence, consumers in both countries enjoy a wider choice and, given the utility function which rewards product diversity, they achieve, *ceteris paribus*, a higher level of welfare. In this respect, this model is consistent with the findings of monopolistic competition models of trade based on the assumption of firms characterized by homogeneous cost functions. However, a major qualification is necessary.

Proposition 6.12: The number of variety effect on consumer welfare is not symmetric in the two countries.

For any given N_t^{**}, the welfare gain brought about by trade is larger in the country whose consumers were worse off, in terms of number of available varieties, in autarky. It was found in Chapter 5 that for sufficiently large σ and/or δ, that is for a sufficiently tough price competition, the autarkic number of firms in the more efficient country is smaller than in the foreign and less efficient country. It follows that $(N_t^{**}-N_h^{**})>(N_t^{**}-N_f^{**})$. Hence, when the structural parameters of the model are such that price competition is sufficiently fierce, the home country will benefit more from the wider choice which results from the opening up of trade. The opposite will happen for sufficiently low levels of price competition, when $N_h^{**}>N_f^{**}$ and thus $(N_t^{**}-N_h^{**})<(N_t^{**}-N_f^{**})$. Clearly, in this latter case the less efficient country will benefit more from trade liberalization as far as the number of variety effect on consumer welfare is concerned.

6.9.1.2. The price effect

From equation *(6.12)* it is easy to show that, for any given value of δ and σ, P_t^{**} is positively related to ϕ. In fact, the larger is the efficiency gap between countries, the lower will be the average efficiency level of the integrated economy which is reflected in a higher price index. By comparing P_t^{**} to the two countries' autarkic price indexes, it is clear that $P_h^{**}<P_t^{**}<P_f^{**}$ for all values of σ, δ and ϕ. It follows that

> **Proposition 6.13:** In terms of **purchasing power**, trade makes consumers worse off in the more efficient country and better off in the less efficient one.

These points are shown in Figure 6.18. Note that change in the expected scale of production as a result of trade is not reflected in the price effects of trade. As a result the better (worse) exploitation of economies of scale in the more (less) efficient country does not lead to an increase (reduction) of consumer welfare[10].

6.9.1.3. Net effect on consumer welfare

The above analysis clearly indicates that

> **Proposition 6.14:** In the foreign country trade will unambiguously generate an increase in consumer welfare.

As was established, trade has a positive effect on the foreign country's consumer welfare both *via* the increase in the number of varieties it generates and *via* the change in the price index which

[10] As was previoulsy noted, a change in the expected elasticity of scale will only be reflected in firms' monopoly power and profitability.

enters consumers' demands. Thus, given that both the price and the variety effects are positive, foreign consumers will always be made better off by trade.

In the home country, however, the price effect and the variety effect have opposite welfare impacts on consumers. In order to solve this ambiguity, we shall compare the autarkic and free-trade indirect utility functions for the home country. The autarkic indirect utility function is given by equation *(3.64)*. Analogously, the free-trade indirect utility function will be given by

$$W_t = A \; N_t^{1/(\sigma-1)} \; P_t^{-\eta} \tag{6.30}$$

Note that, given the symmetry of the two countries demand sides, the indirect utility in *(6.30)* is common to both countries.

Proposition 6.15: Trade brings about a net welfare loss to consumers in the more efficient country for sufficiently large values of δ, σ and η.

As can be seen from Figure 6.19, the ratio $\frac{W_h}{W_t}$ *ceteris paribus* increases in δ, σ which determine the fierceness of price competition. For large values of σ, the loss of price efficiency outweighs the positive welfare effect of a larger number of varieties, because relative prices between variants become more important in determining consumer choice, as the degree of substitutability between them increases. Also, the larger is the gap between the most and the least efficient firms in the industry, determined by δ, the higher is the pre-trade efficiency, and the larger will be the (negative) impact on efficiency generated by trading with a less efficient country. The role of η in determining the net effect of trade on consumer welfare is obvious considering that the larger is this parameter the larger will be the welfare impact of an increase in the price index stemming from the trade induced industry-wide efficiency loss. Finally, note that for any given level of autarkic welfare, the free-trade indirect utility level is smaller the larger is the efficiency gap between countries. This is due to the role of the latter in determining the efficiency loss in the home industry which occurs after trade.

Corollary 6.2: The welfare gains of consumers in the less efficient country are larger the larger are σ and δ.

This is clearly a reflection of the role of these parameters in determining the extent of the industry wide efficiency gains the country experiences. Although foreign consumers are always made better off by trade, the **extent** of the welfare gains they experience trade will depend on the structural parameters of the model: the tougher is price competition the more selective the free-trade competitive process on the foreign industry will be and, as a result, the larger will be consumers' welfare gains.

6.9.2. Producer welfare

We now turn our attention to the impact of trade on producers' surplus. Denoting the overall autarky industry surplus profit in country j by T_j^{**}, we have $T_j^{**}=N_j^{**}R_j^{**}$ where N_j^{**} and R_j^{**} are explained in equations *(5.14)*, *(5.16)*, *(3.26)* and *(5.20)* respectively. The corresponding measures $T_{tj}^{**}=N_{tj}^{**}R_{tj}^{**}$ can be constructed under trade, by using equations *(6.28)* and *(6.29)*.

Proposition 6.16: Trade liberalization increases (reduces) the overall industry profit in the more (less) efficient country.

This result stems from two different elements. On one hand, as we saw, by reducing industry efficiency in the home country and increasing it in the foreign one, trade increases (reduces) the number of firms surviving in the home (foreign) country, that is $N_h^{**} < N_{th}^{**}$ and $N_f^{**} > N_{tf}^{**}$. On the other hand, from the comparison between the autarkic and free-trade expected profits it emerges that expected profitability increases in the home country and falls in the foreign one as a result of free-trade. This effect is clearly related to the changes in the expected scale of production brought about by trade.

Hence, it is obvious that within each country, trade has asymmetric effects on consumers and producers, with the nature of the conflict of interest between these two groups of agents being the opposite in the two countries. The possibility of a conflict between the welfare effects of trade on consumers and producers has already been noted in the literature, but not in symmetric monopolistically competitive models[11].

Because of the opposite welfare effects on producers and consumers, the net welfare effects of trade at the industry level are ambiguous. This is particularly true for the foreign country where, for all values of the relevant parameters, trade makes consumers better off and producers worse off. The situation is less ambiguous

[11] For instance, Anderson, Donsimoni and Gabszewicz (1989) find, within an oligopolistic homogeneous good framework, that consumers always gain because of a larger overall output and lower prices. Producers, on the contrary, may lose if the price reduction dominates the output effects of trade, thus leading to a fall in profits.

as far as the home country is concerned, given that there are intervals of σ and δ for which the consumer and the producer welfare effects of trade go in the same direction.

6.9.3. Net industry welfare

As was argued in Chapter 3, given the difference in the units of measurement between the welfare indicators used for consumers and producers, the assessment of the net welfare effects at the industry level is not straightforward and cannot consist of a simple sum of the two. To this end, the autarkic and free-trade total industry profit, T_j^{**} and T_{tj}^{**}, have been **"deflated"** by the industry price indexes P_j^{**} and P_t^{**} respectively, so as to reflect their **value** in terms of the differentiated good[12]. Hence for the two countries, the overall industry welfare under autarky is given by the following welfare measure

$$W_j^{\Delta} = W_j + \frac{N_j^{**}}{P_j^{**}} R_j^{**} = W_j + \frac{T_j^{**}}{P_j^{**}} \tag{6.31}$$

where $j=h,f$ and the superscript s stands for **social** welfare[13] (given the partial equilibrium framework, social and industry welfare are used interchangeably). Analogously, under free-trade total welfare

---

[12] The same limitation identified in Chapter 3 is present here, namely that, due to the difficulty within this framework of determining the number of failed entry attempts, the following welfare measures do not take into account the foregone entry cost incurred by those firms that chose not to enter the industry.

[13] Here we conform to the trade literature where it is common to assume that at the margin a pound's worth of gain or loss to producers and consumers has the same social value.

will be given by

$$W^{\Delta}_{tj} = W_t + \frac{N^{**}_{tj}}{P^{**}_t} R^{**}_{tj} = W_t + \frac{T^{**}_{tj}}{P^{**}_t} \tag{6.32}$$

Note that under free-trade consumer welfare is common to both countries but producer welfare is country specific, given the different number of firms and expected profit of the two countries.

> **Proposition 6.17:** Circumstances can be identified in which trade generates total welfare losses for either country.

As can be seen from Figure 6.20, other things being equal, for sufficiently large values of η and δ there is an interval of σ where the ratio $(W^{\Delta}_h/W^{\Delta}_{th})$ exceeds unity, *i.e.* trade generates total welfare losses in the more efficient country. In general, the more important is price competition the higher will be the welfare cost generated by the increase in the industry price index which results from the loss of efficiency brought about by trade. The larger are these parameters the more costly in terms of welfare will be the increase in the industry price index resulting from the loss of efficiency brought about by trade. As we saw, on consumer side the indirect utility function falls as σ and η increase. Similarly, on producer side, if the country enjoys a favourable efficiency gap trade generates an increase in nominal profits, but this effect is reduced by the higher price index. Total welfare, however, will be improved by trade when price competition is very tough and the great majority (if not the whole) of the free-trade market is held by home producers[14].

---

[14] In these circumstances the dominant role is played by the effects of trade on industry profitability. Also, the very tough price competition, *via* its effect on β^{**}_t, will limit the extent of the adverse effect of trade on industry's efficiency and price index.

In general, for the less efficient economy, trade brings about positive welfare effects. This is shown in Figure 6.21. Hence, given that as we saw producer surplus falls whereas consumers' (indirect) utility increases, the latter effect must dominate the former in the aggregate. Indeed, the negative impact on producers is alleviated by the fall in average price which increases the **"purchasing power"** of the total industry profit. Note, however, that for very small values of η, W^s_f/W^s_{tf} becomes greater than unity for sufficiently tough levels of price competition (see Figure 6.22). Clearly, for a low price elasticity of aggregate demand the rise in purchasing power brought about by trade will not generate a consumer welfare increase sufficiently large to compensate for the fall in nominal profit (which is larger the tougher is price competition).

A significant implication of this analysis is that - unless the price elasticity of aggregate demand is very small - the move to free-trade increases the foreign country's overall industry welfare even for those values of the parameters for which the whole integrated market is served by the more efficient country. Clearly, from an analytical point of view, this means that the welfare gain of consumers more than compensates for producers' loss. Although this reflects the fact that consumers are not affected by where the purchased varieties are produced and benefit from the wider choice and the lower price index, this result clearly depends on the partial equilibrium nature of the analysis. Thus, once again, the results call for an extension of the analysis to a general equilibrium framework, so as to allow - amongst other things - for an endogenization of income[15].

6.10. A BRIEF DIGRESSION ON THE EMPLOYMENT EFFECTS OF TRADE

The assumption of firm cost heterogeneity was shown to allow for the endogenous determination of industry efficiency. The implications of this for market structure and trade have been extensively discussed. In this section we highlight another advantage which stems from this hypothesis.

It is a common feature of trade models *à la* Krugman to impose a labour market clearing condition which - by acting as an economy resource constraint - allows for the endogenous determination of the number of firms. In our model this constraint needs not to be imposed because, given firm's heterogeneity, market structure is determined by the process of competitive selection. The analysis has thus been carried out in a partial equilibrium framework, with an implicit hypothesis of perfectly elastic factor supplies. A drawback of this modelling strategy is the impossibility of determining factor prices and how they are affected by trade. But it has the advantage of allowing one to identify some of the implications of trade for the level of industry employment, **given** the level of economic activity of the economy as a whole.

Following the standard Krugman model, let us assume that labour is the only factor of production and that labour requirement for producing good i in country j is given by

[15] The total industry welfare analysis has been conducted for a given ratio A/K. Although the above measures of welfare are not very sensitive to the magnitude of A/K, it is worth mentioning that the welfare worsening effects of free-trade for the home country are more enhanced the larger is A relative to K.

$$L_{ji} = \alpha + \gamma_{ji} Q_{ji} \tag{6.33}$$

with α, $\gamma_{ji} > 0$. For a given nominal wage w, equation *(6.33)* yields the following cost function

$$C_{ji} = w(\alpha + \gamma_{ji} Q_{ji}) \tag{6.34}$$

which is clearly equivalent to equation *(5.4)* for $w\alpha = K$ and $\beta_{ji} = w\gamma_{ji}$. If, by confining the analysis to a partial equilibrium setting, we rule out the income effects of trade, *i.e.* we do not allow for changes in the wage rate and in incomes, then from our previous analysis we can infer the effects of trade on the employment level in the industry. From equation *(6.33)* it is obvious that - *ceteris paribus* - the higher the firm's efficiency, the lower will be its labour demand. Hence, the following results will hold:

(1) In the more efficient country trade reduces average industry efficiency and increases both the number of firms operating in steady-state and their expected output scale. This will result in an increase in the level of employment.

(2) On the contrary, the level of employment in the industry will fall in the less efficient country whose average efficiency will increase, the number of firms will fall and, due to the persistence of the country's efficiency disadvantage, their expected output scale becomes smaller. In the limiting case where the whole of the integrated market is held by the more efficient country, all employment in the industry will be eliminated.

(3) It is obvious that the costs and gains in terms of employment in

the two countries are determined by the extent to which trade changes their relative efficiency which was shown to depend *ceteris paribus* on the size of the efficiency gap. Thus, other things being equal, the larger is the difference in terms of efficiency between the two countries the more significant will be the employment losses in the less efficient country and the employment gains in the more efficient one.

Although in this framework the rest of the economy is kept in the background, this analysis suggests that trade will have effects on the inter-industry distribution of employment within the economy. The partial equilibrium analysis allows one to understand the nature of the changes in the employment level in the differentiated industry only and the economy wide implications cannot be assessed. A general equilibrium framework would be required to analyze the impacts of trade on other sectors' employment and on aggregate income. This will be left for future research.

6.11. CONCLUSIONS

This chapter has analyzed the implications of technical heterogeneity amongst firms and countries for the patterns of international specialization and for the welfare effects of trade. It is shown that the usual result according to which countries share symmetrically the free-trade market no longer holds.

On the whole the recognition of technical asymmetries within and between countries has been shown to pose a significant challenge to the welfare implications of standard models. Two types of efficiency effects of trade have been identified. At the industry level, the average competitiveness of countries is affected by the change in the strength of the competitive selection process within each country. As a result, the efficiency structure of the industry only improves in the country which has a cost disadvantage. By competing with a less efficient trading partner, a fall in average industry efficiency occurs in the more efficient country, where some **types** of firms which would have been forced to exit the industry under autarky are able to survive under trade. Due to the persistence of the inter-country efficiency gap, however, trade is shown to increase (reduce) the scale of production of firms in the more (less) efficient country.

The results obtained in this chapter cast doubt on the efficacy of trade in generating welfare gains based on its rationalizing effects on industries. Indeed, depending on the magnitude of the price elasticities of demand and the degree of heterogeneity amongst firms, the fall in efficiency - reflected in the price effects of market integration - can be sufficient to generate a net welfare loss in the home country. This welfare loss does not occur in the less efficient country. Whilst it is not possible to draw clear-cut normative conclusions from this partial equilibrium analysis, these results challenge the view emerging from the monopolistic competition literature that the introduction of imperfectly competitive markets may strengthen the case for free-trade.

To some extent, of course, the results of this analysis depend on the functional forms adopted. Nevertheless, they are sufficiently general to support the view that the existence of technical heterogeneity can cause adverse welfare effects of trade. Obviously, the problem of **losing because of trade** is of great interest with respect to integration processes between similar countries, like those forming the European Union, which are undoubtedly characterized by different types of specialization and sectoral developments.

Finally, note that the partial equilibrium analysis carried out in this model does not allow one to examine what happens to factor markets and assumes that all inputs are available to the industry at constant prices[16]. This is an obvious limitation, particularly in a model where the two trading countries are characterized by different factor productivities so that trade is likely to affect factor prices, together with the rate of employment of resources, and feed back through this into the industry structure. The departure from a partial equilibrium framework remains an interesting possibility for future research.

16 These issues are discussed by Gasiorek, Smith and Venables (1991) within a general equilibrium model with intermediate goods and several factors of production.

Appendix 6.1

THE FREE-TRADE PRICE INDEX

In this appendix we derive the free-trade price index of equation *(6.13)*. From the definition of price index in equation *(6.3)* the steady-state price index for the integrated economy is given by

$$P_t^{**} = \left[\frac{1}{N_t^{**}} \sum_j \sum_{i=1}^{N_{tj}^{**}} P_{tji}^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{A6.1}$$

which can be rewritten as

$$P_t^{**} = \left\{ \frac{1}{N_t^{**}} \left[\sum_{i=1}^{N_{th}^{**}} P_{tji}^{1-\sigma} + \sum_{i=1}^{N_{tf}^{**}} P_{tji}^{1-\sigma} \right] \right\}^{\frac{1}{1-\sigma}} \tag{A6.2}$$

Note that under free-trade, the "sub-industry" price index in each country will be given by

$$P_{tj}^{**} = \left[\frac{1}{N_{tj}^{**}} \sum_{i=1}^{N_{tj}^{**}} P_{tji}^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{A6.3}$$

where $j=h,f$. From *(A6.3)* we get

$$\sum_{i=1}^{N_{tj}^{**}} P_{tji}^{1-\sigma} = N_{tj}^{**} \left(P_{tj}^{**} \right)^{1-\sigma} \tag{A6.4}$$

which can be substituted into *(A6.2)* to yield

$$P_t^{**} = \left(\frac{N_{th}^{**}}{N_t^{**}} P_{th}^{**1-\sigma} + \frac{N_{tf}^{**}}{N_t^{**}} P_{tf}^{**1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{A6.5}$$

Given the country-specific distribution under free-trade, equation *(A6.3)* for the two countries will yield

$$P_{th}^{**} = \left(\frac{1}{N_{th}^{**}} \right)^{\frac{1}{1-\sigma}} \left(N_{th}^{**} \int_{1-\delta}^{\beta_t^{**}} \left(\frac{\sigma}{\sigma-1} \beta_i \right)^{1-\sigma} \frac{1}{\beta_t^{**}-1+\delta} \, d\beta_h \right)^{\frac{1}{1-\sigma}}$$

$$= \frac{\sigma}{\sigma-1} \left(\frac{\beta_t^{**2-\sigma} - \left(1-\delta\right)^{2-\sigma}}{(2-\sigma)(\beta_t^{**}-1+\delta)} \right)^{\frac{1}{1-\sigma}} \tag{A6.6}$$

and

$$P_{tf}^{**} = \left(\frac{1}{N_{tf}^{**}} \right)^{\frac{1}{1-\sigma}} \left(N_{tf}^{**} \int_{1+\phi-\delta}^{\beta_t^{**}} \left(\frac{\sigma}{\sigma-1} \beta_{fi} \right)^{1-\sigma} \frac{1}{\beta_t^{**}-1-\phi+\delta} \, d\beta_f \right)^{\frac{1}{1-\sigma}}$$

$$= \frac{\sigma}{\sigma-1} \left(\frac{\beta_t^{**2-\sigma} - \left(1+\phi-\delta\right)^{2-\sigma}}{(2-\sigma)(\beta_t^{**}-1-\phi+\delta)} \right)^{\frac{1}{1-\sigma}} \tag{A6.7}$$

(A6.6) and *(A6.7)* can now be used to rewrite *(A6.5)* which, given equations *(6.15)* and *(6.16)* will become

$$P_t^{**} = \left(\frac{\sigma}{\sigma-1}\right) \left(\frac{1}{2-\sigma}\ \frac{2\beta_t^{**2-\sigma} - \left(1-\delta\right)^{2-\sigma} - \left(1+\phi-\delta\right)^{2-\sigma}}{2\beta_t^{**}-2+2\delta-\phi}\right)^{\frac{1}{1-\sigma}} \qquad (A6.8)$$

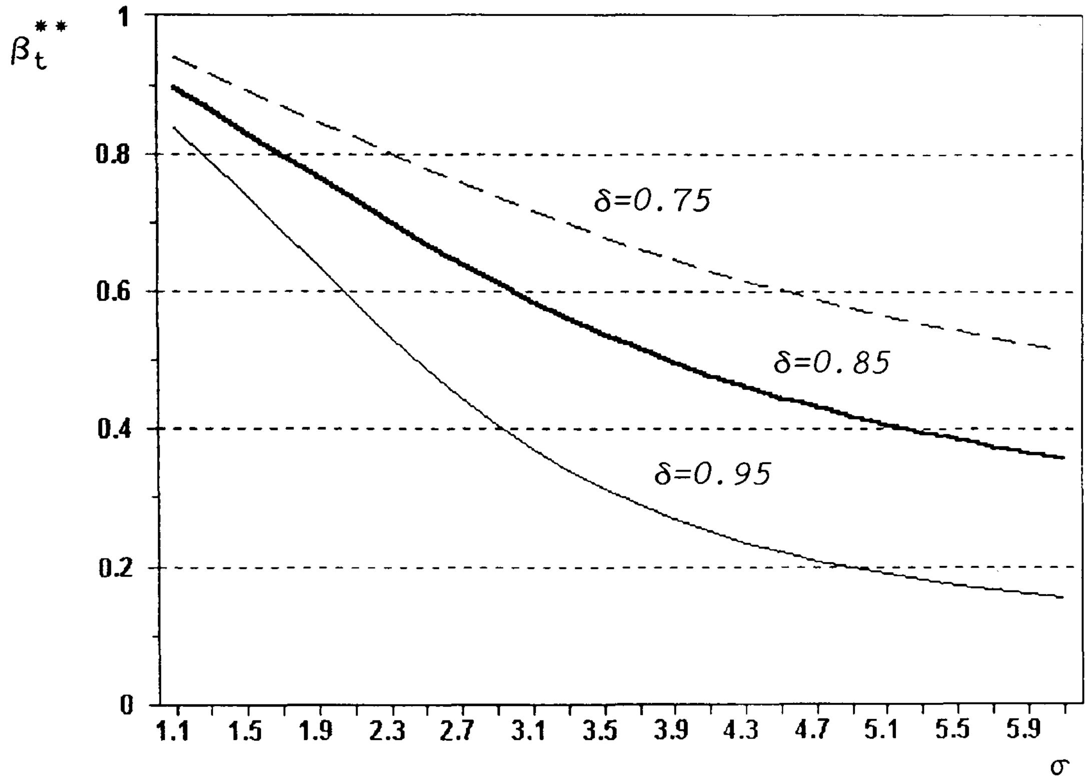

Fig. 6.1 Free-trade

Steady-state efficiency cut-off point (ϕ=0.11)

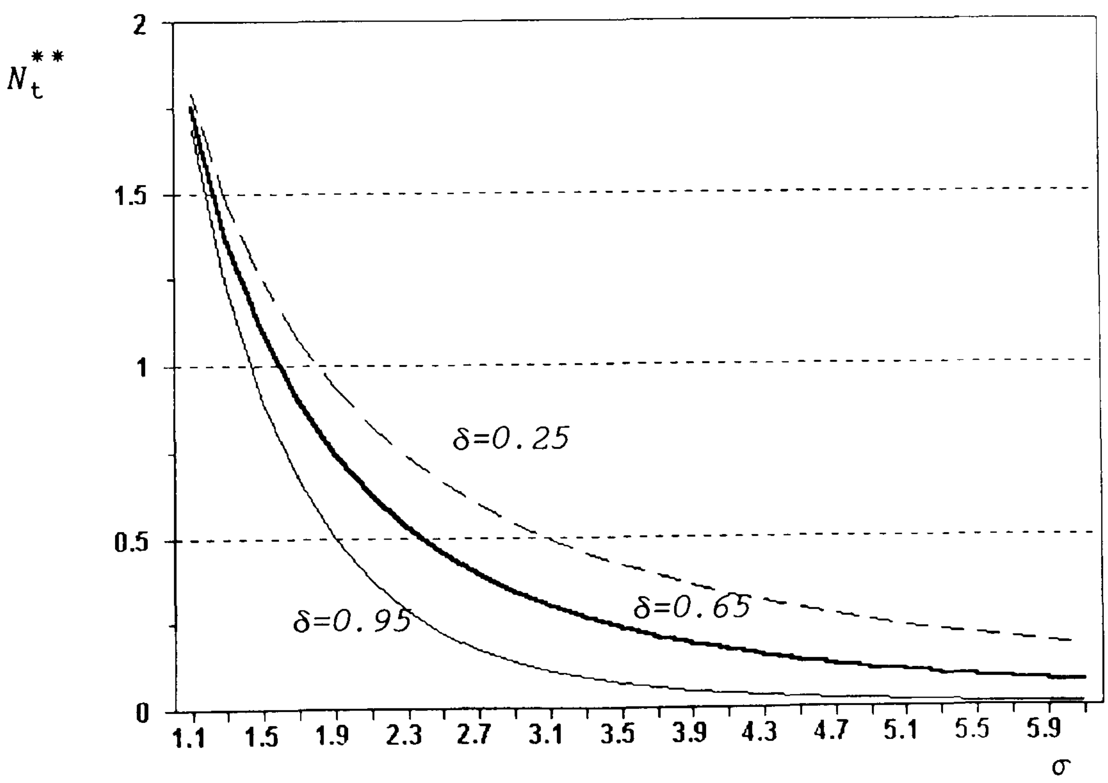

Fig. 6.2 Free-trade

Steady-state number of firms (ϕ=0.11, η=1)

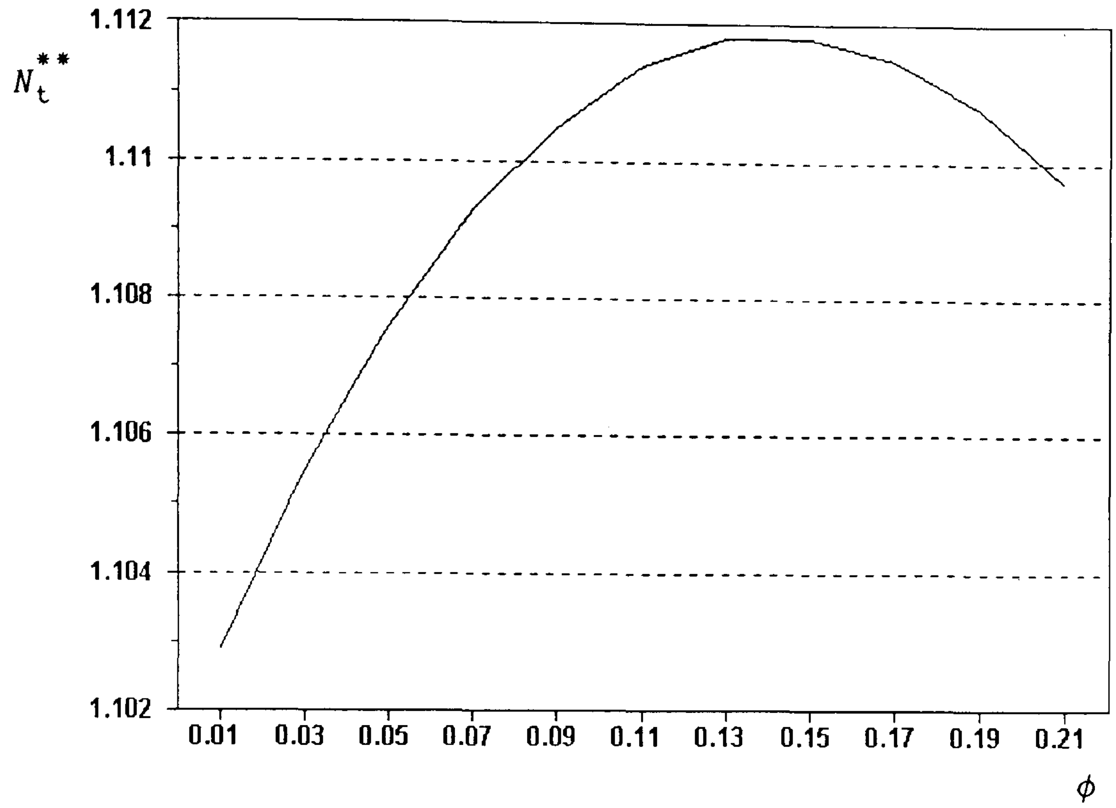

Fig. 6.3 Free-trade

Steady-state number of firms *(δ=0.35, σ=1.7, η=0.9)*

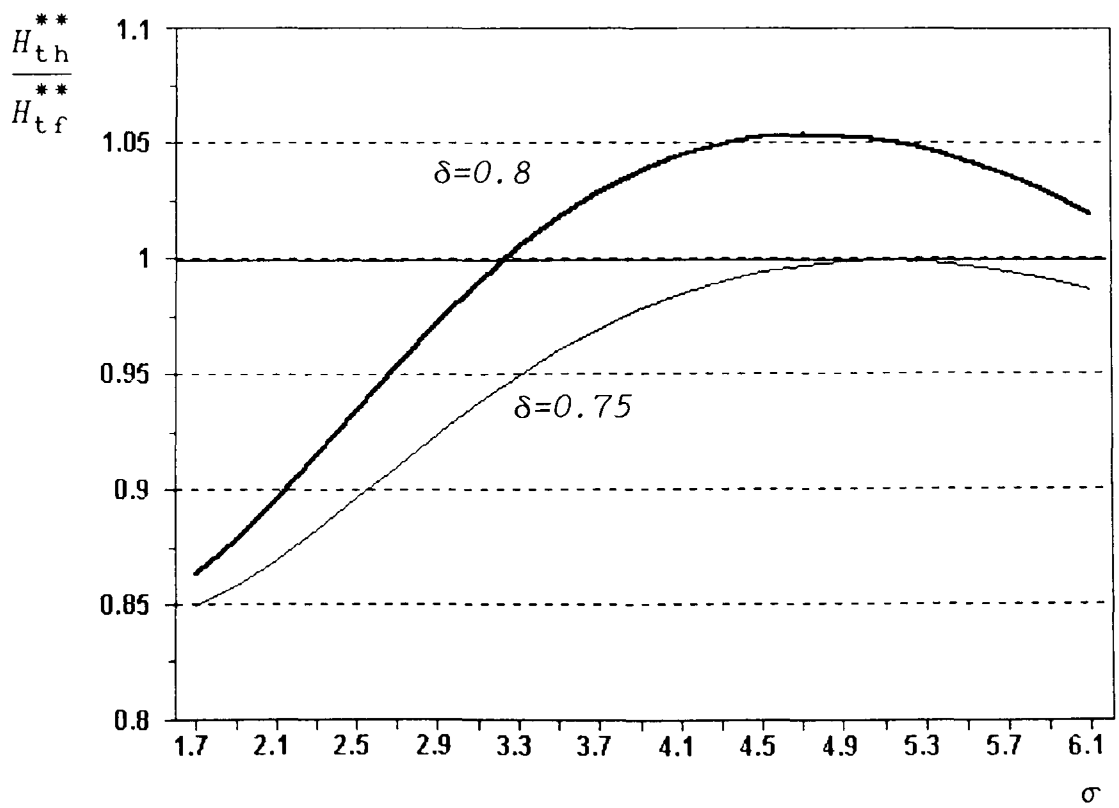

Fig. 6.4 Free-trade

Steady-state industry concentration *(ϕ=0.11, η=1)*

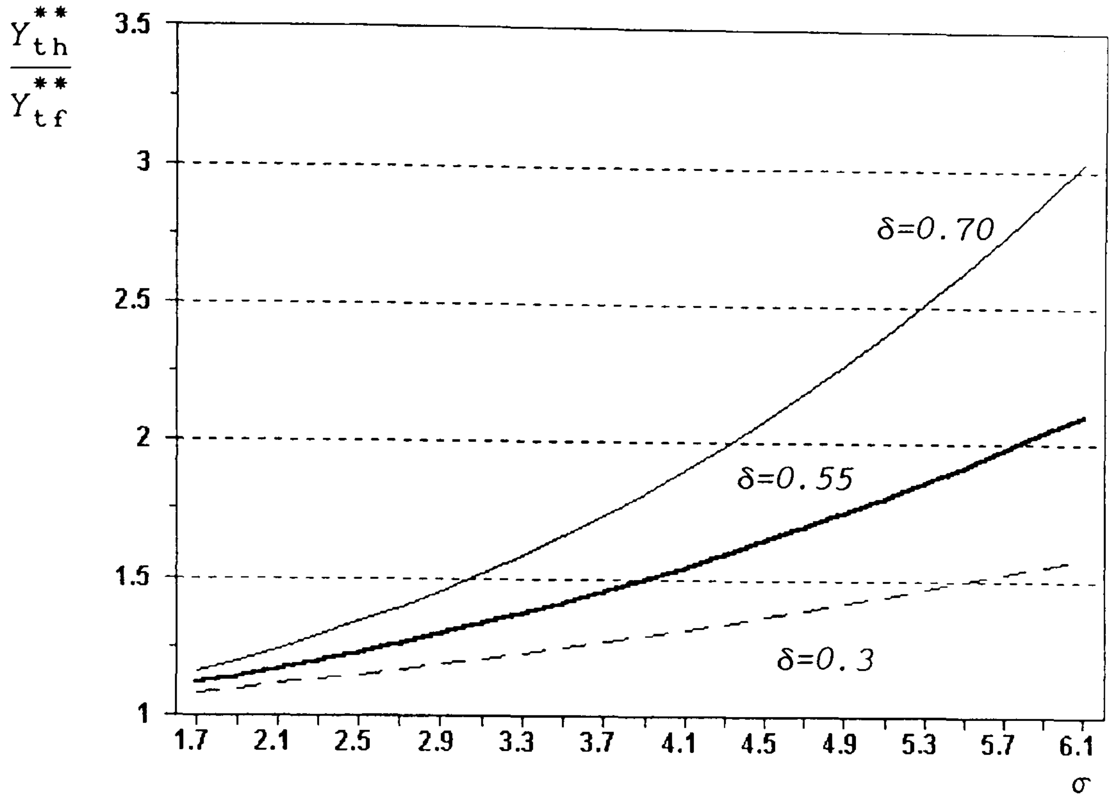

Fig. 6.5 Free-trade

Steady-state expected output (ϕ=0.11, η=1)

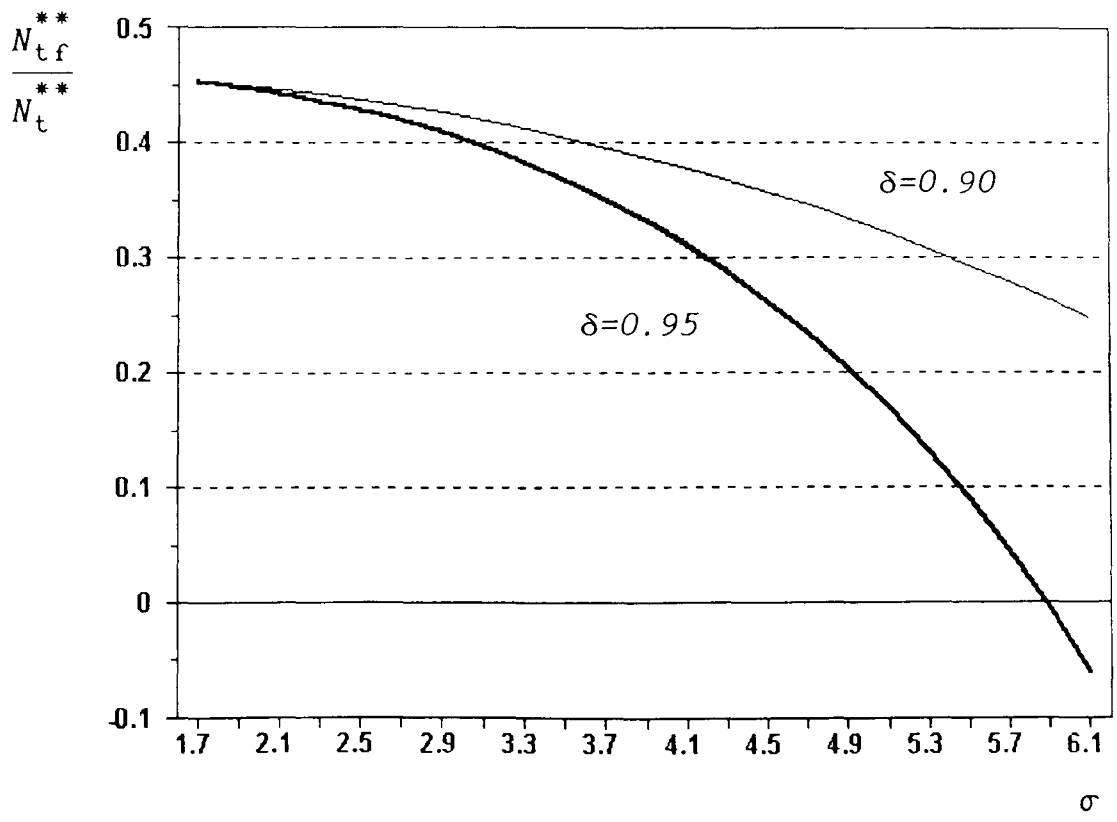

Fig. 6.6 Free-trade

Foreign share of total firms (ϕ=0.11, η=1)

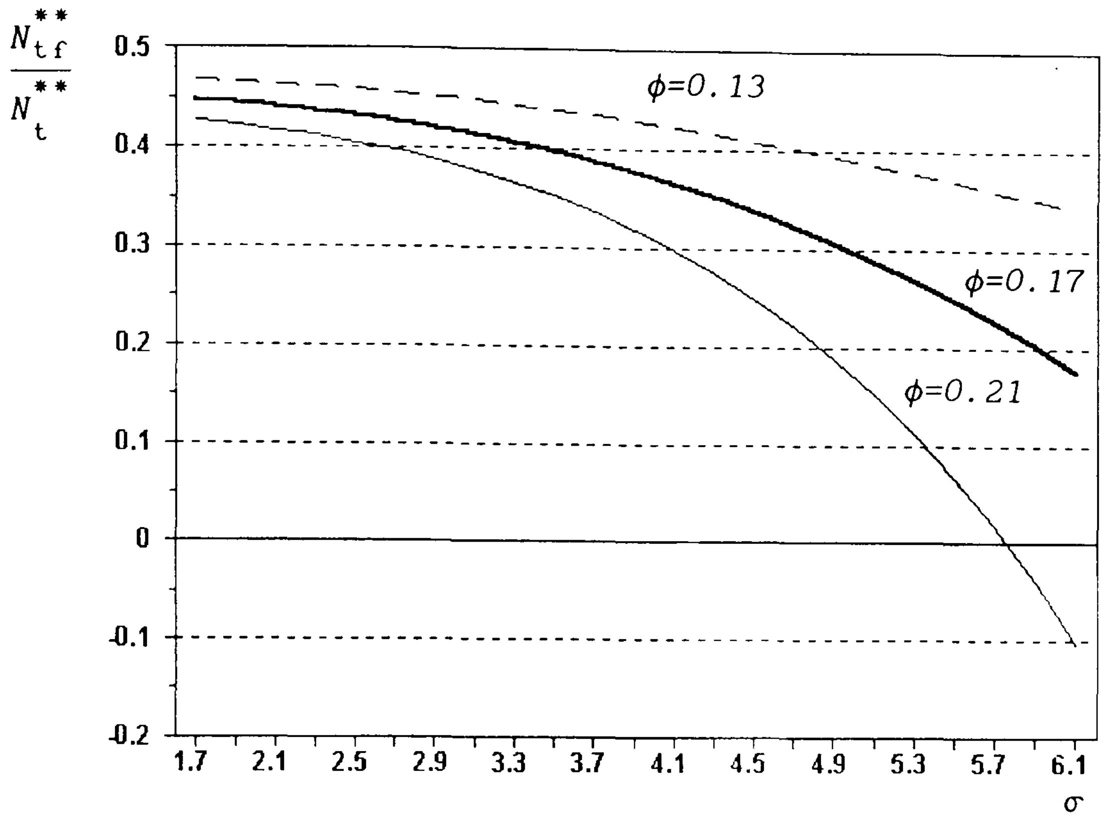

Fig. 6.7 Free-trade

Foreign share of total firms *(δ=0.90, η=0.7)*

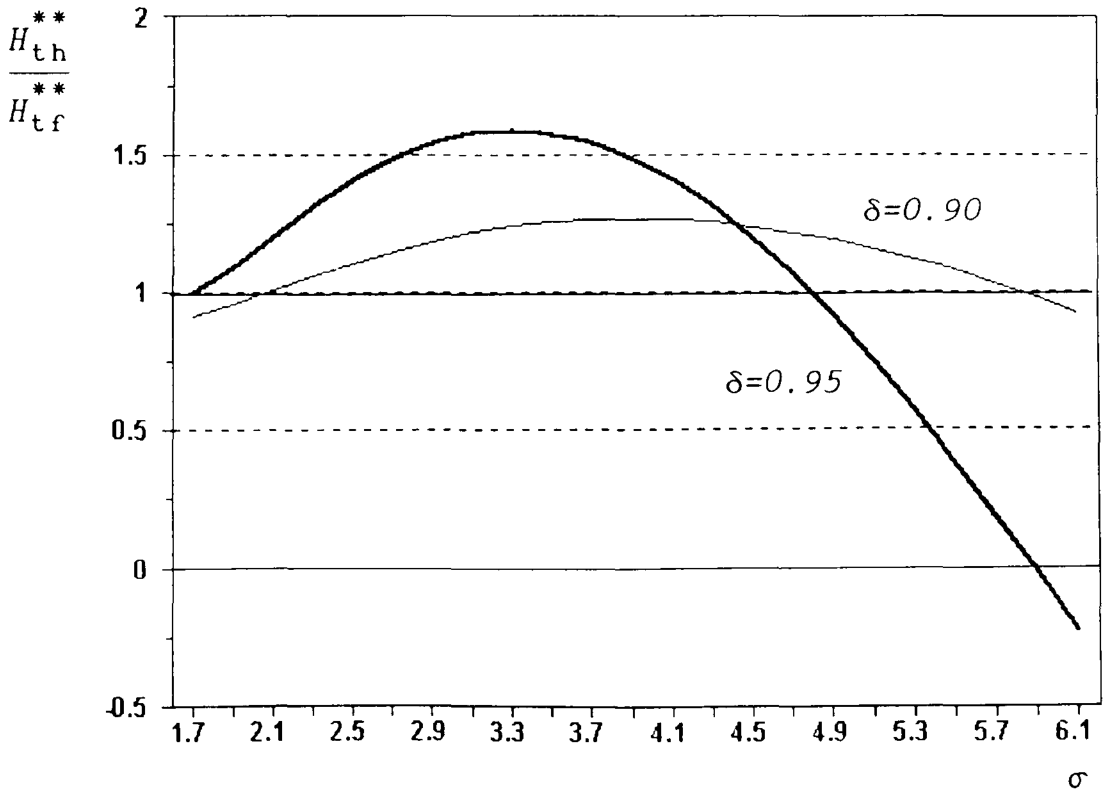

Fig. 6.8 Free-trade

Steady-state industry concentration *(ϕ=0.11, η=1)*

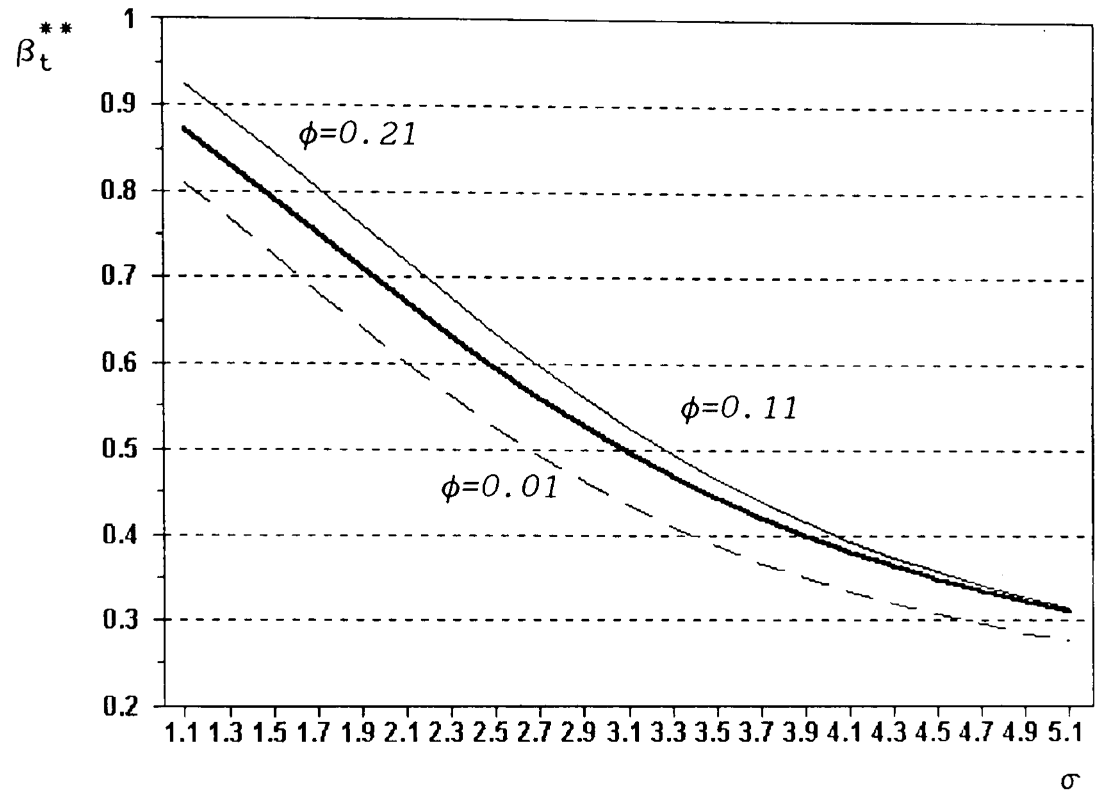

Fig. 6.9 Free-trade

Steady-state efficiency cut-off point *(δ=0.90)*

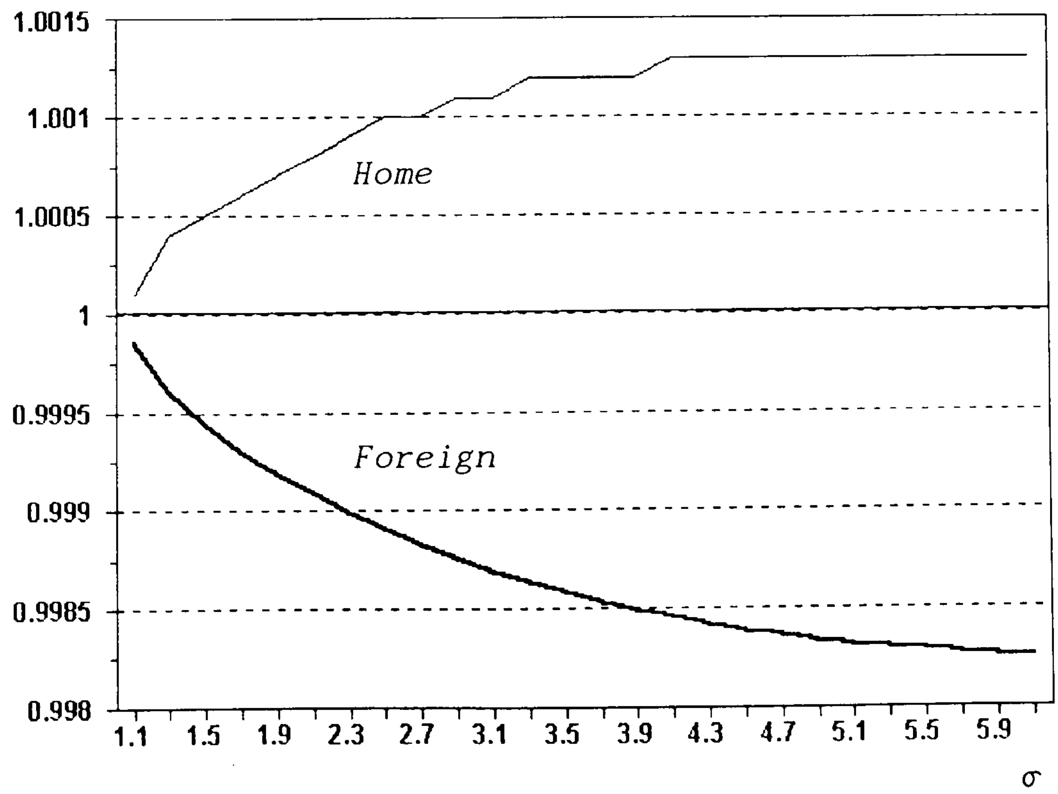

Fig. 6.10 The effects of trade on the elasticity of scale

(δ=0.9, η=1, ϕ=0.01)

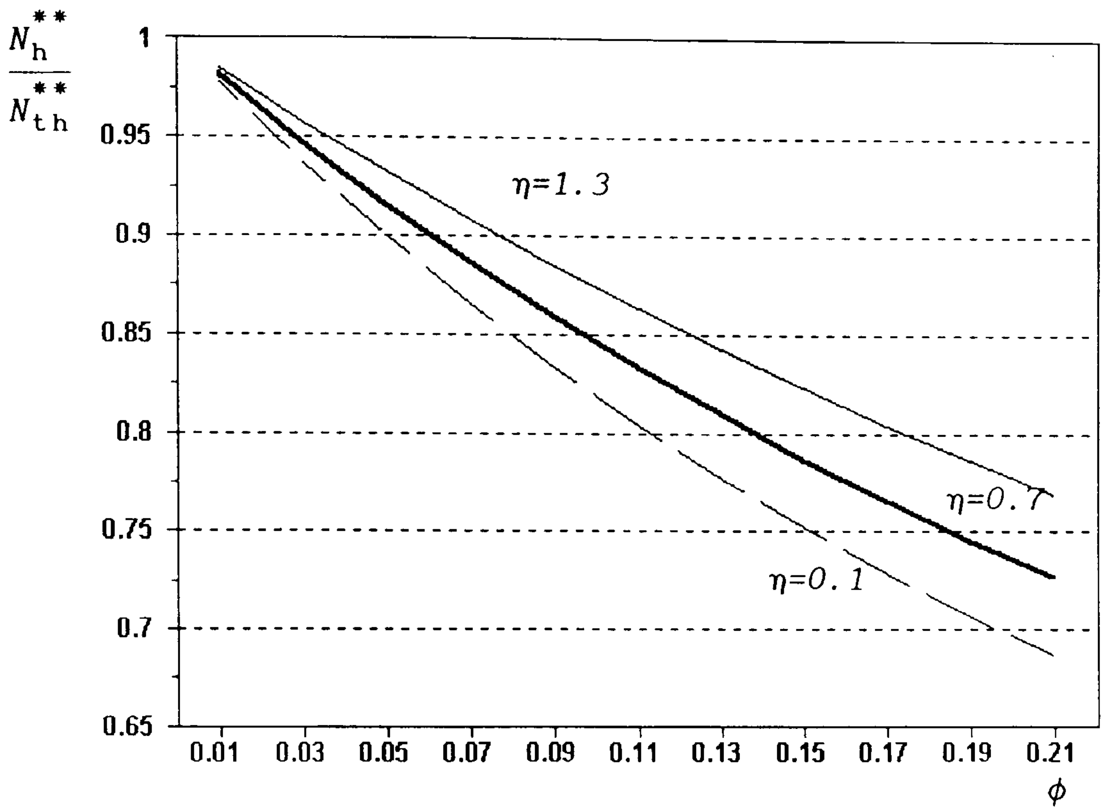

Fig. 6.11 The effects of trade on the number of firms

Home ($\delta=0.3$, $\sigma=1.7$)

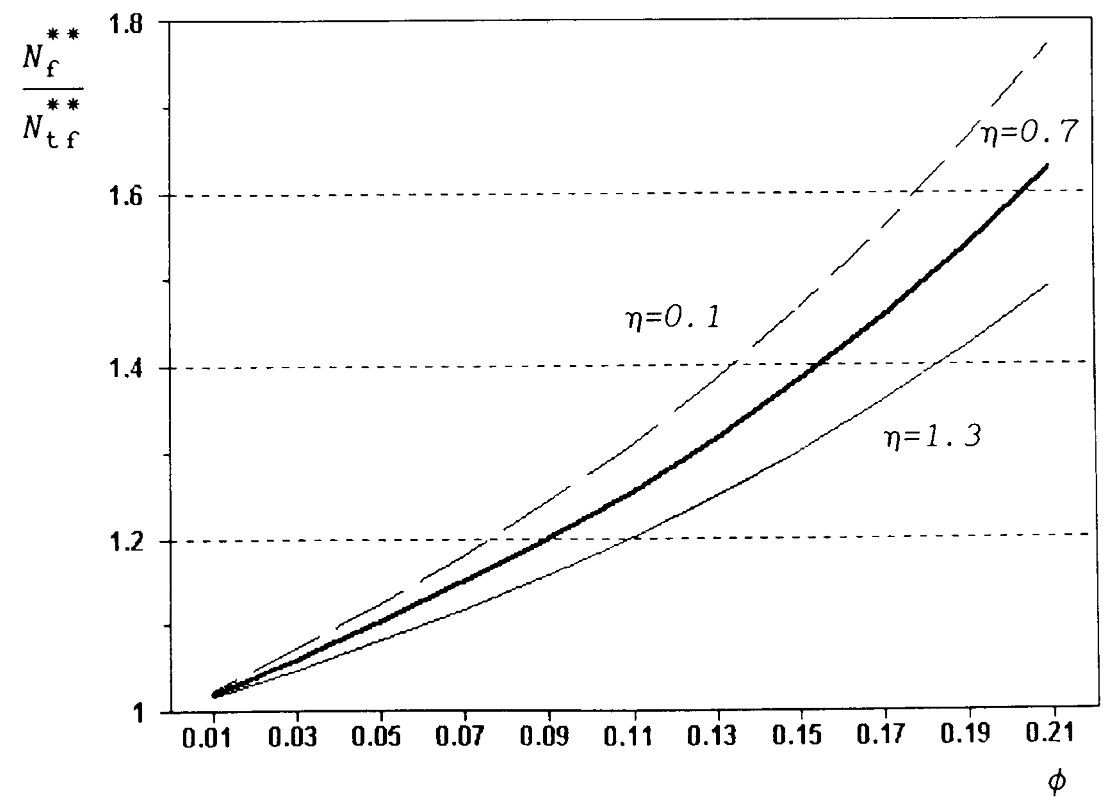

Fig. 6.12 The effects of trade on the number of firms

Foreign ($\delta=0.3$, $\sigma=1.7$)

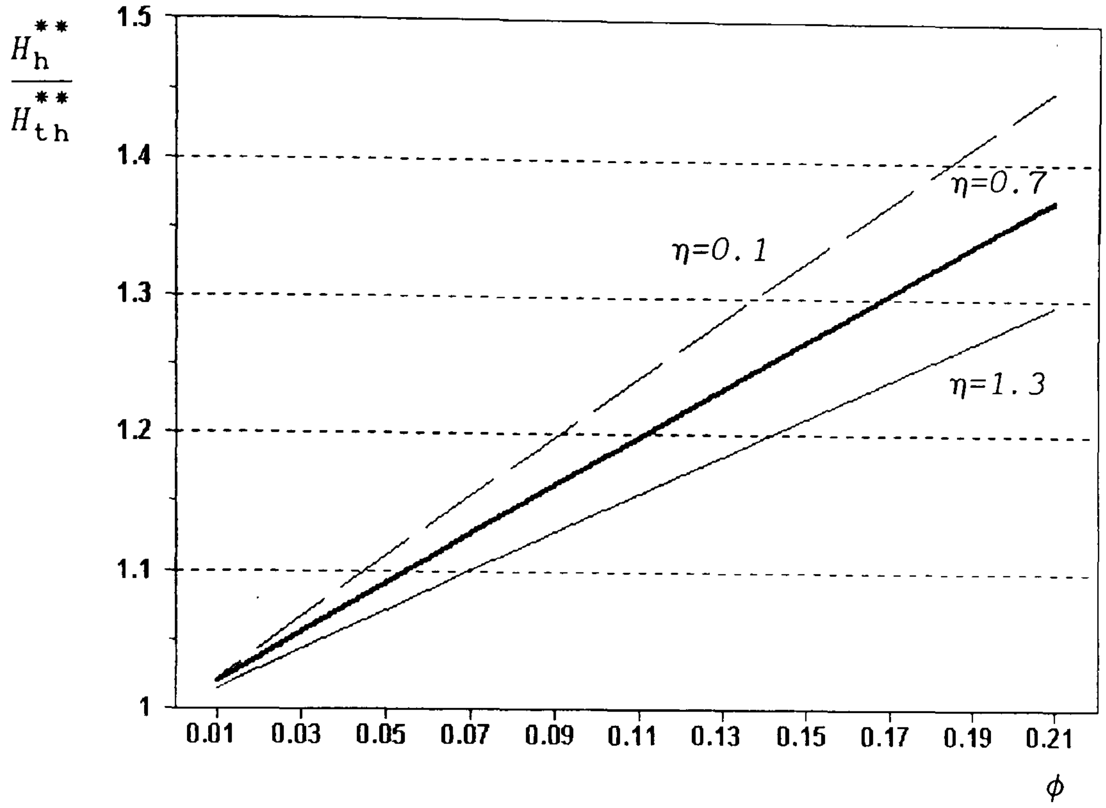

Fig. 6.13 The effects of trade on industry concentration

Home (δ=0.3, σ=1.7)

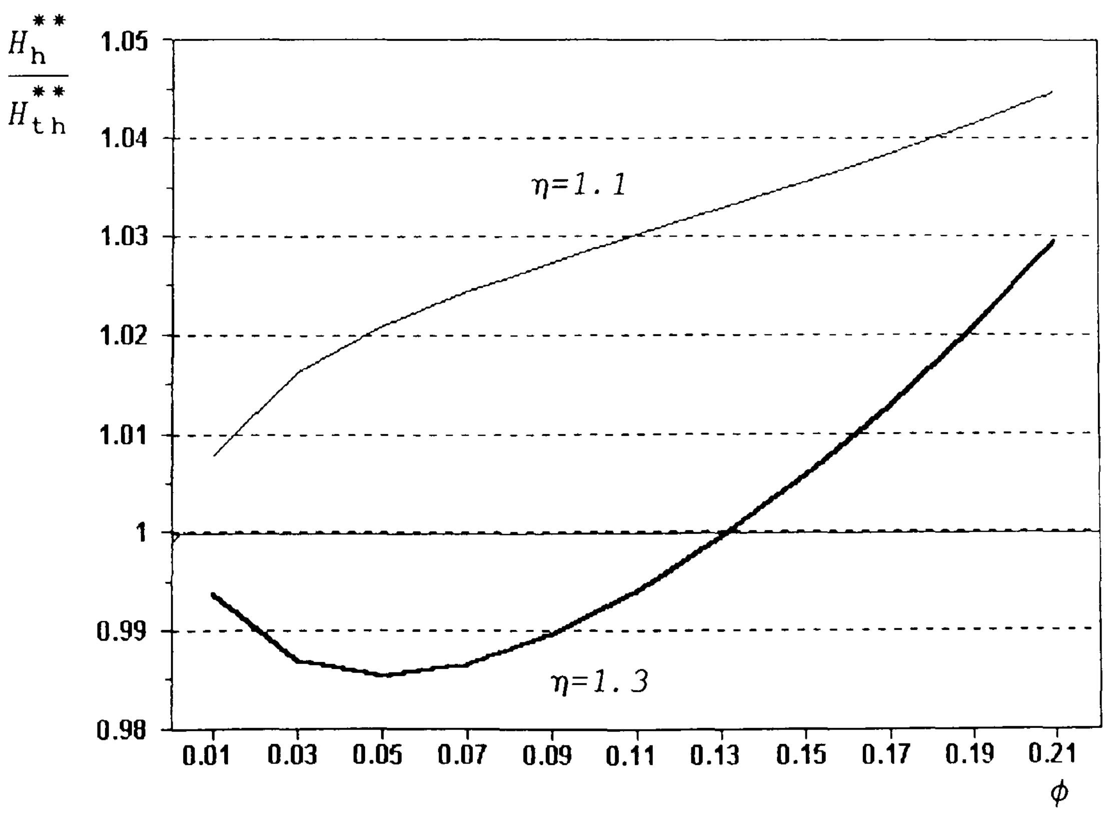

Fig. 6.14 The effects of trade on industry concentration

Home (δ=0.95, σ=4.1)

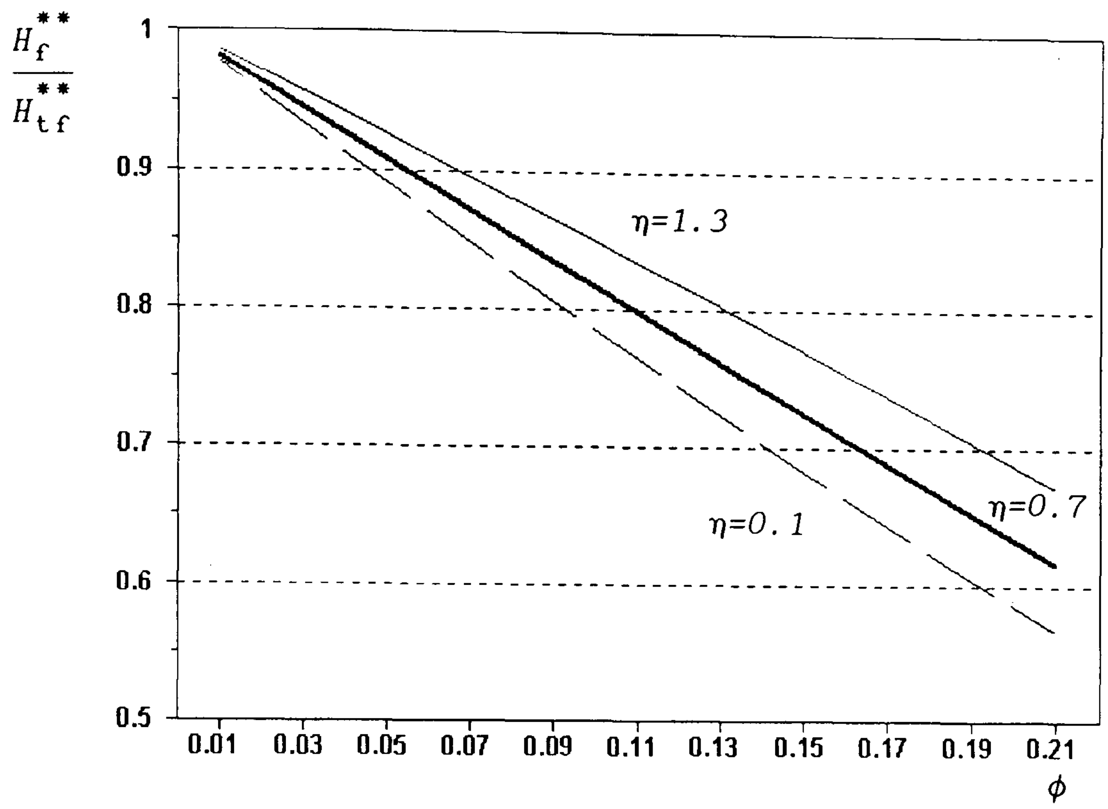

Fig. 6.15 The effects of trade on industry concentration

Foreign ($\delta=0.3$, $\sigma=1.7$)

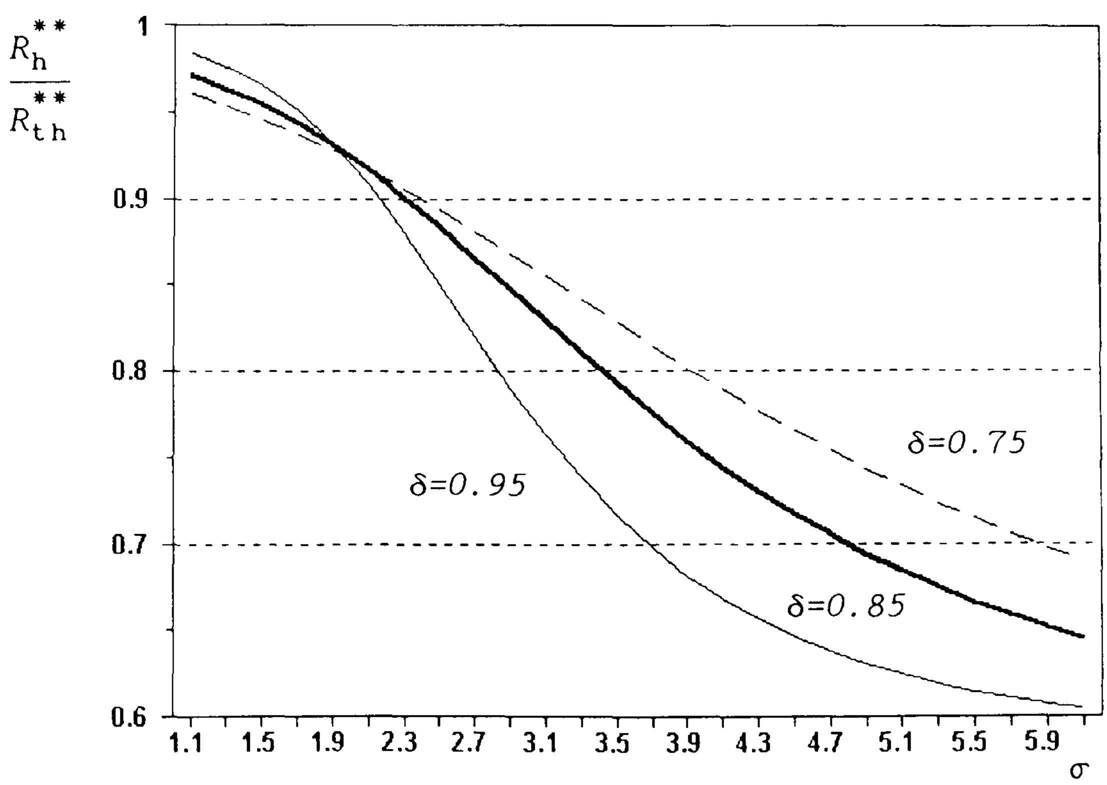

Fig. 6.16 The effects of trade on expected profits

Home ($\phi=0.11$, $\eta=1$)

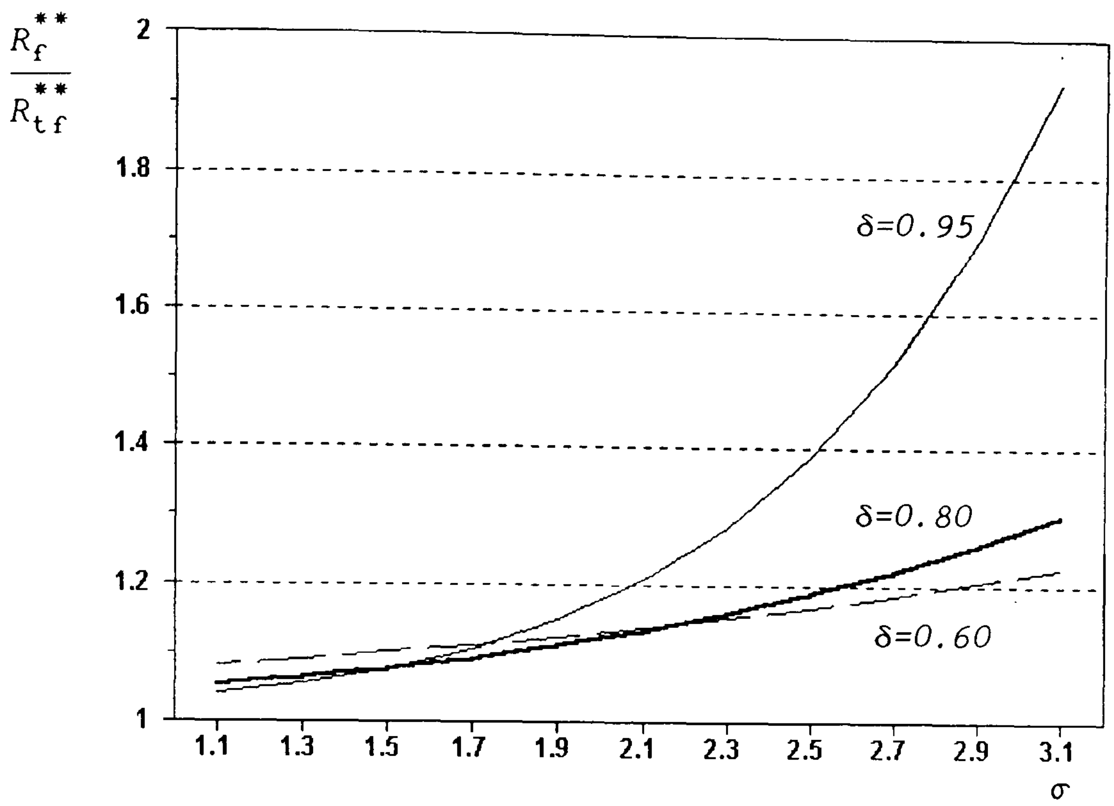

Fig. 6.17 The effects of trade on expected profits

Foreign *(ϕ=0.11, η=1)*

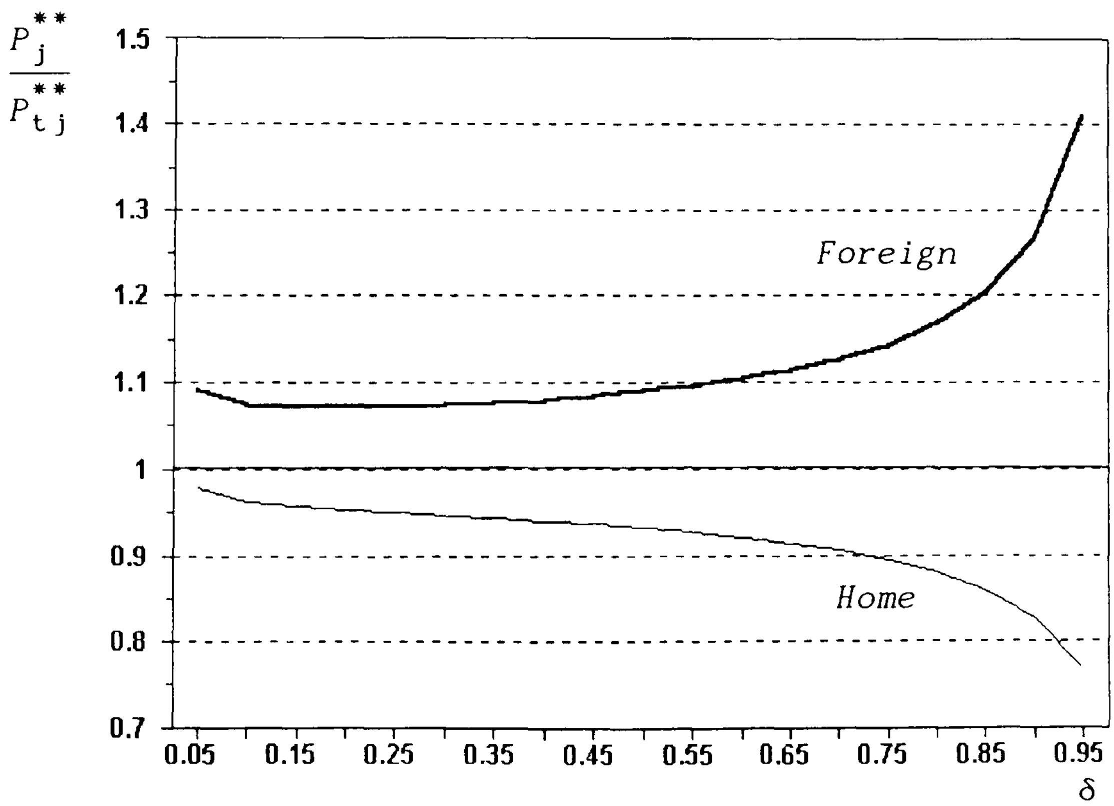

Fig. 6.18 The effects of trade on the price index

(ϕ=0.11, σ=2.7)

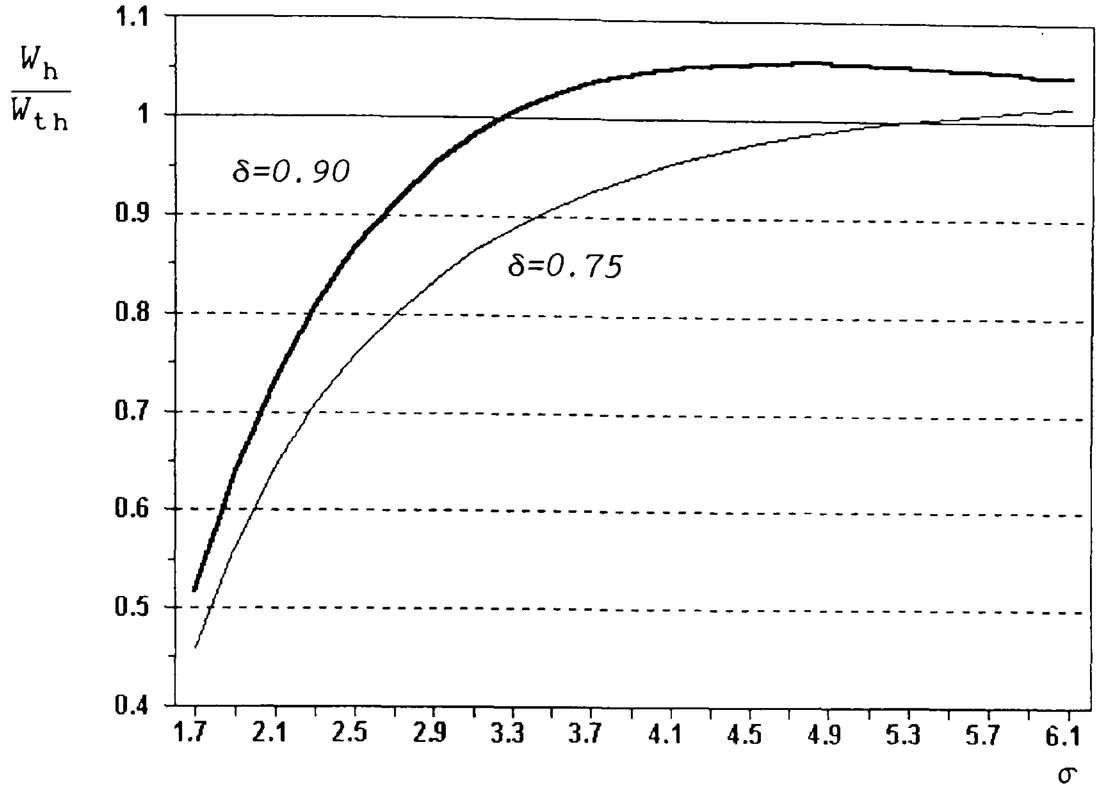

Fig. 6.19 The effects of trade on consumer welfare

Home *(ϕ=0.11, η=1.5)*

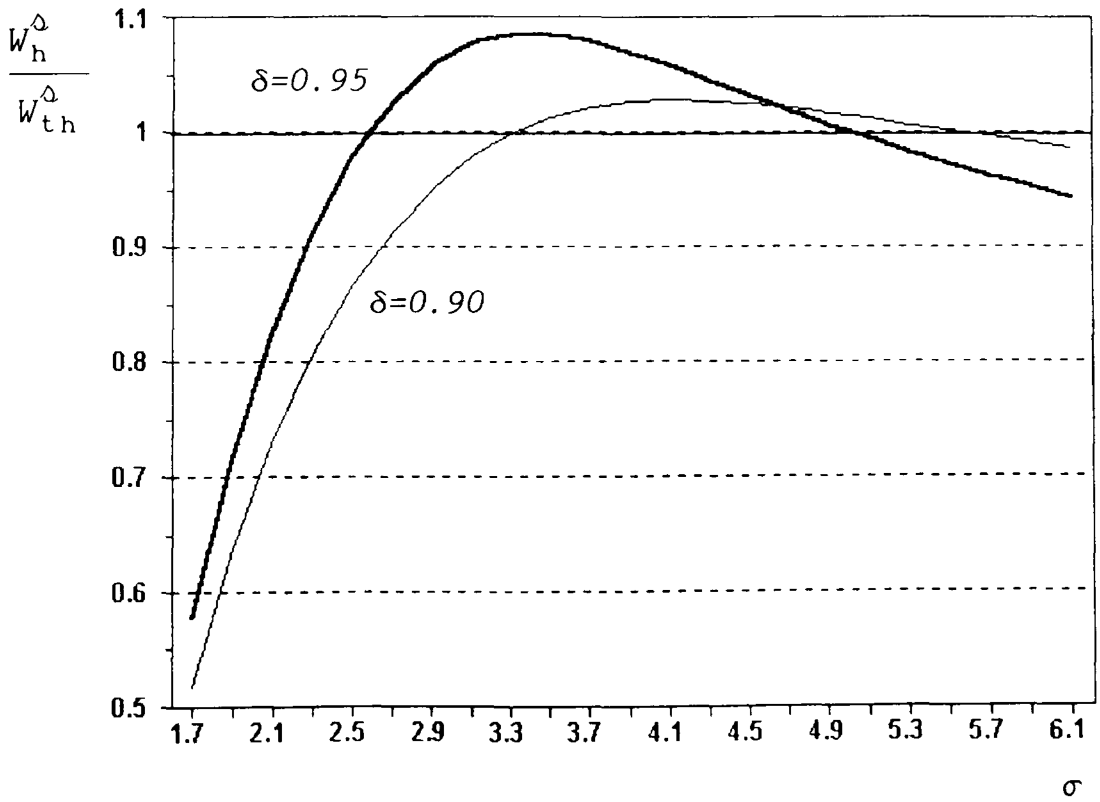

Fig. 6.20 The effects of trade on total industry welfare

Home *(ϕ=0.11, η=1.5)*

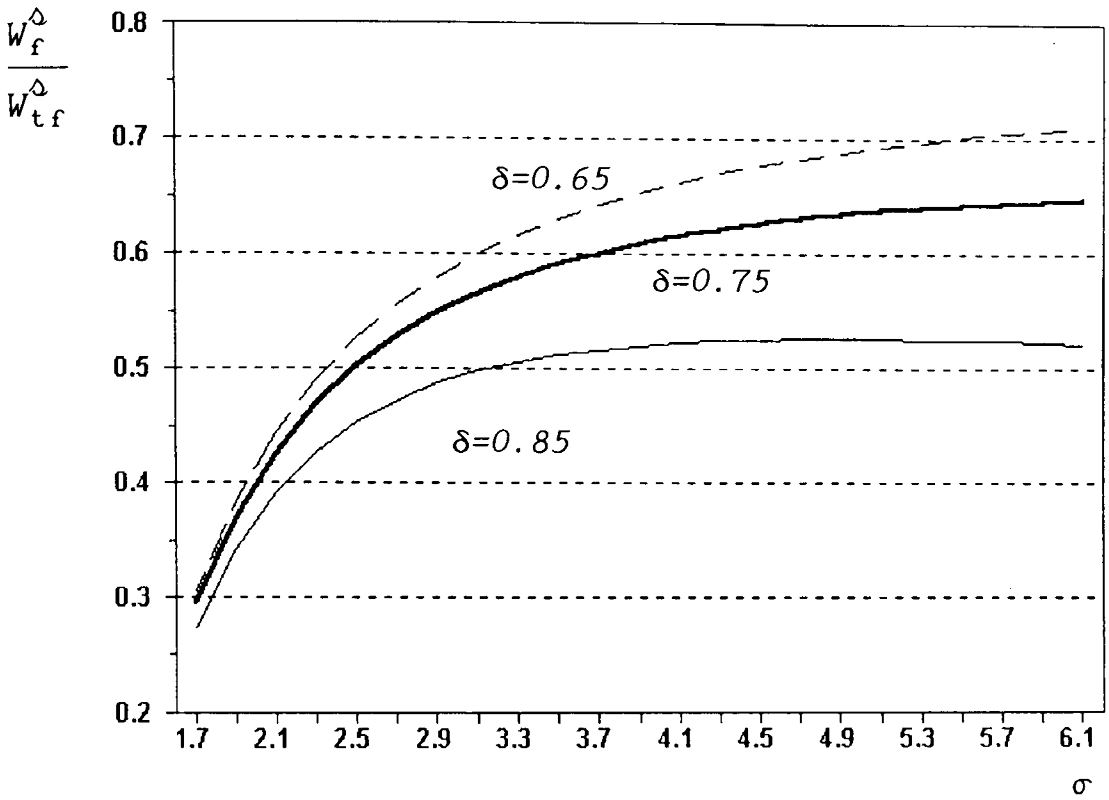

Fig. 6.21 The effects of trade on total industry welfare

Foreign ($\phi=0.11$, $\eta=1.5$)

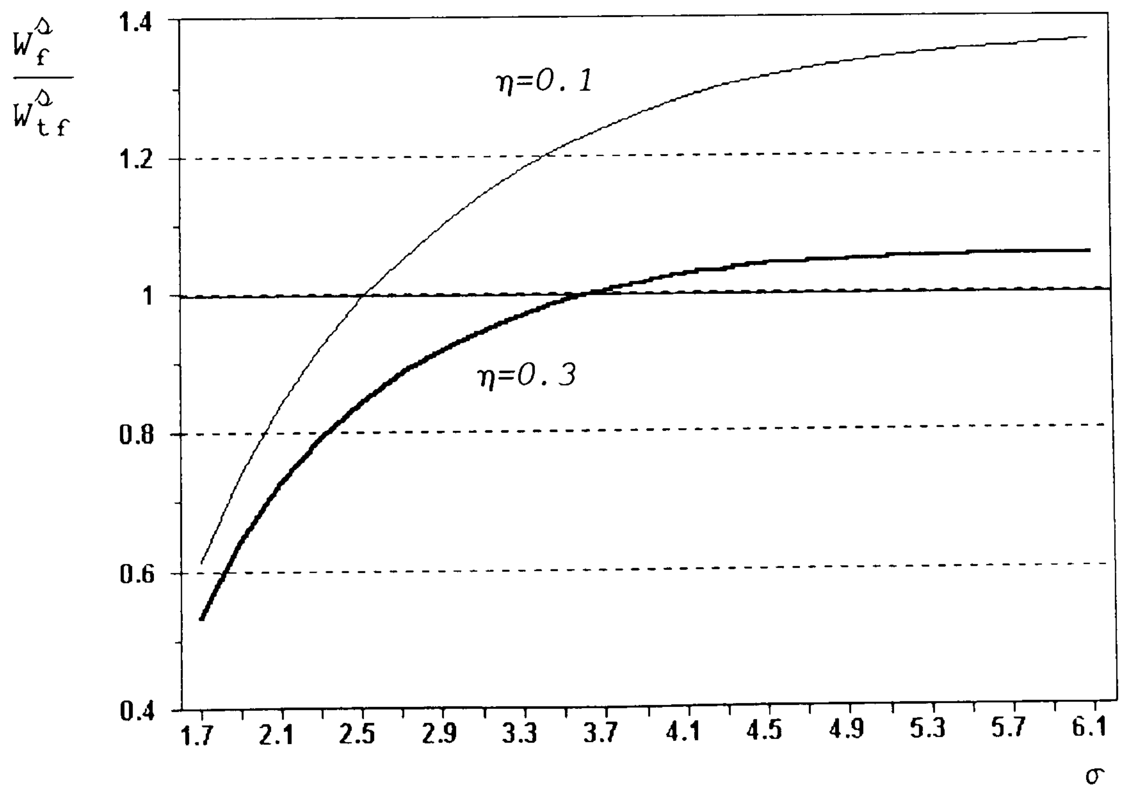

Fig. 6.22 The effects of trade on total industry welfare

Foreign ($\delta=0.95$, $\phi=0.11$)

Chapter 7

CONCLUSIONS

7.1. A SUMMARY

This thesis has developed a monopolistically competitive framework characterized by technical heterogeneity amongst competitors. The results of the analysis are relevant for both industrial organization and international trade theory.

As was highlighted in Chapter 3, one of the most important implications of allowing for technical heterogeneity amongst firms in a monopolistically competitive market is the **endogenization of the steady-state level of industry efficiency** which is determined by competition amongst firms. In presence of cost asymmetries, free-entry leads to a competitive selection process whereby more efficient entrants displace less efficient incumbents in the industry. Contrary to the standard model, entry will not drive profits to zero and the long-run equilibrium will be characterized by a dispersion of efficiencies, prices, market shares and profits.

The implications of technical heterogeneity for international trade have been analyzed by constructing a two country model where an efficiency gap between the two competitors takes the form of a difference in the mean of their marginal cost distributions. Due to the assumed inter-firm and inter-country efficiency gaps, the emergence of asymmetries in equilibrium market shares and in the distribution of potential welfare gains stems from **within** the differentiated product industry.

It was shown that trade has two types of efficiency effects and that in both cases the two countries are affected asymmetrically.

At the **industry level**, trade modifies the efficiency structure of the population of firms in the industry. Thus, by unifying the competitive conditions in which firms from different countries operate, trade liberalization reduces (increases) the competitive pressure in the more (less) efficient country. As a result, types of technology which would not be sufficiently efficient under autarky manage to survive under trade in the more efficient country. The opposite happens in the less efficient economy, where the number of types of technology surviving under trade is smaller than in autarky. Hence, at the industry level, trade acts as a rationalizing force only for the country which suffers the efficiency disadvantage. It was noted that this efficiency effect of trade does not take place in the standard specification of the monopolistic competition model where all firms are technologically identical.

At the **firm level** trade affects the expected scale of production which increases (falls) in the more (less) efficient country. This is because the persistent efficiency gap between the two countries' technologies implies the existence of a bias in favour of the (on average) cheaper home country's varieties. This second effect resembles the one emerging from Krugman's variable elasticity case, where trade increases the scale of production. However, in the two models the change in the elasticity of scale reflects different factors. Apart from the asymmetric way in which it takes place in the two countries, in this model the change in the degree of exploitation of scale economies does not influence consumer welfare but only producers' monopoly power and profits.

The asymmetric nature of the efficiency effects of trade on the two countries is crucial in determining the pattern of trade and its welfare implications. With respect to the former, we showed that the free-trade market is not symmetrically shared by the two countries, with the more efficient one selling more varieties in larger quantities. Furthermore, for sufficiently tough levels of price competition, the less efficient country's industry was shown to be totally displaced by its more efficient competitor.

Given some of the adverse efficiency effects emerging from trade, this analysis clearly casts doubt on the widespread view that trade, by increasing competition, is a generalized source of industry rationalization. These results are also not fully consistent with the view that - however costly for the individual industry within the individual country - trade is nevertheless increasing overall world market efficiency. Although the less efficient country may be completely forced out of the industry, the surviving country will serve the world market at an average efficiency level which is lower than the pre-trade one and which will be reflected in a price index which is higher than the autarkic one.

Finally, our analysis showed the gains from trade not to be symmetrically distributed across the two countries and circumstances were identified in which at least one country experiences a net welfare loss from trade. Furthermore, asymmetry also characterizes the welfare effects between producers and consumers within each country.

A casual observation of the real world suggests that the widespread assumption of identical technologies between competitors within and between countries is not sustainable. In this thesis we have shown that by moving beyond this restrictive assumption new insights can be gained into the working of the competitive forces in industries exposed to international competition and important features of the real world can be captured.

7.2. FUTURE RESEARCH

A number of possible developments can be envisaged following this study, some related to the issues which directly arise from this analysis, and some entailing the exploration of new directions of research.

The analysis carried out in this thesis has significant normative implications.

In the new trade theory the strategic trade policy argument for protection has only been analyzed within oligopolistic models. Clearly, the profit shifting argument cannot be applied in situations, as those described by the standard monopolistic competition model, where supernormal profits are eliminated by entry. But given the long-run persistence of profits in this model, it is possible to envisage the desirability of government policies aimed at ensuring a larger share of international profits to domestic firms. Hence one could address, as was recently done by Neary (1994) within an oligopolistic framework, the issue of whether government subsidies should be targeted towards weaker firms or towards more competitive ones. The answer to this question is not obvious, given that the policy - by affecting the degree of heterogeneity between firms -

would influence the process of competitive selection[1].

The possible disappearance of the less efficient country's industry may provide justification for protectionist policies. These could be supported, for instance, by arguments pointing at the strategic importance of the industry. Given the partial equilibrium nature of the analysis carried out in this study, it was not possible to analyze these issues and, hence, to reach clear-cut normative conclusions. However, this type of analysis could be carried out, for instance, within a general equilibrium framework where the differentiated product industry generates knowledge spill-overs for other sectors of the economy.

The extension of the analysis to a general equilibrium framework would have other advantages. For example, it would allow one to examine the effects of trade on factor prices and employment. As noted in Chapter 6, the effects of trade on the two countries efficiencies and market structure clearly imply some intersectoral reallocation of resources which could not be captured within this partial equilibrium framework.

An explicit characterization of the location problem of firms in the integrated market is an interesting direction of research. As was discussed in Chapter 6, in this thesis it was assumed that location in the two countries is random. This must obviously be seen as a first step towards a more interesting and plausible modelling strategy which sees location as a rational choice. Clearly, as suggested in Chapter 6, this line of research would require the

[1] This dimension is not present in Neary (1994) in whose model there is no entry.

modification of this basic model and some other sources of asymmetries between the two economies may have to be introduced (such as transport costs, or asymmetric preferences) to rule out the trivial case of all firms locating in the more efficient country. Interesting policy issues would then emerge. For instance, one could analyze the role of industrial policy in affecting the location decisions of firms.

The above extensions are relatively straightforward and would not require significant departures from the framework developed here. More substantial developments would be involved by the introduction of learning and innovation processes which here were ruled out by assumption. Allowing for firm-specific innovation (as an asymmetry generating factor) and/or diffusion and imitation between firms (as convergence factors) would clearly represent a stimulating line of research. A first step in this direction would be to assume that the dispersion of firms in the industry is not with respect to their marginal costs, but with respect to the effectiveness of R&D expenditure (one of firms' choice variables) in increasing efficiency. This could easily be extended to incorporate knowledge spill-overs between firms and/or firm-specific technical progress and learning dynamics in the research process. Interesting issues could then arise, concerning for instance the role of industrial and technology policy in affecting the dispersion of firms' efficiencies and through it the nature of the competitive selection process in the industry. Clearly, in considering these and other extensions there will be a trade-off between analytical tractability and the introduction of new features.

Bibliography

Abd-el-Rahman K. (1991) "Firms' Competitive and National Comparative Advantages as Joint Determinants of Trade Composition", *Weltwirtschaftliches Archiv*, 83-97.

Anderson K. L. (1936) "Tariff Protection and Increasing Returns", in *Explorations in Economies: Notes and Essays Contributed in Honor of F. W. Taussing*, McGraw-Hill.

Anderson S. P. and de Palma A. (1987) "The Logit as a Theoretical Model of Product Differentiation: Market Equilibrium and Social Optimum", *Northwestern University, Center for Mathematical Studies in Economics and Management Science*, *Discussion Paper* 752.

Anderson S. P. and de Palma A. (1988) "Spatial Price Discrimination with Heterogeneous Products", *Review of Economic Studies*, 55, 573-592.

Anderson S. P. and de Palma A. (1992) "The Logit as a Model of Product Differentiation", *Oxford Economic Papers*, **44**, 51-67.

Anderson S. P., de Palma A. and Thisse J. -F. (1988a) "A Representative Consumer Theory of the Logit Model", *International Economic Review*, 29, 461-466.

Anderson S. P., de Palma A. and Thisse J. -F. (1988b) "The C.E.S. and the Logit: Two Related Models of Heterogeneity", *Regional Science and Urban Economics*, **18**, 155-164.

Anderson S. P., de Palma A. and Thisse J. -F. (1989) "Demand for Differentiated Products, Discrete Choice Models, and the Characteristics Approach", *Review of Economic Studies*, 56, 21-35.

Anderson S. P., de Palma A. and Thisse J. -F. (1992a) "Interpretations of the Logit Discrete Choice Model in the Theory of Product Differentiation", in J. M. A. Gee and G. Norman (eds.), *Market Structure and Strategy*, Harvester Wheatsheaf, Hemel Hempstead.

Anderson S. P., de Palma A. and Thisse J. -F. (1992b) "Social Surplus and Profitability under Different Spatial Pricing Policies", *Southern Economic Journal* 59.

Anderson S. P., de Palma A. and Thisse J. -F. (1992c) *Discrete Choice Theory of Product Differentiation*, The MIT Press.

Anderson S. P., Donsimoni M. P. and Gabszewicz J. J. (1989) "Is International Trade Profitable for Oligopolistic Industries?" *International Economic Review*, 30, 725-733.

Archibald G. C., Eaton B. C. and Lipsey R. G. (1986) "Address Models of Value", in J. E. Stiglitz and F. G. Mathewson (eds.), *New Developments in the Analysis of Market Structure*, The MIT Press.

Archibald G. C., and Rosenbluth G. (1975) "The 'New' Theory of Consumer Demand and Monopolistic Competition", *Quarterly Journal of Economics*, 80, 569-590.

Balassa B. (1966) "Tariff Reductions and Trade in Manufactures among the Industrial Countries", *American Economic Review*, 56, 466-473.

Balassa B. (1986) "The Determinants of Intra-Industry Specialization in US Trade", *Oxford Economic Papers*, 38, 220-233.

Baumol W. J., Panzar J. C. and Willig R. D. (1982) *Contestable Markets and the Theory of Industry Structure*, Harcourt Brace Jovanovich, New York.

Beach W. E. (1936) "Some Aspects of International Trade Under Monopolistic Competition", in *Explorations in Economies: Notes and Essays Contributed in Honor of F. W. Taussing*, McGraw-Hill.

Beath J. and Katsoulacos Y. (1991) *The Economic Theory of Product Differentiation*, Cambridge University Press.

Bergstrand J.H. (1983) "Measurement and Determinants of Intra-Industry International Trade", in P. K. M. Tharakan (ed.) *Intra-Industry Trade: Empirical and Methodological Aspects*, North-Holland.

Bhagwati J. (1965) "On the Equivalence of Tariffs and Quotas", in Robert E. Baldwin et al., (eds.), *Trade, Growth, and the Balance of Payments: Essays in Honor of Gottfried Haberler*, Rand McNally, Chicago.

Brander J. A. (1981) "Intra-industry Trade in Identical Commodities", *Journal of International Economics*, 11, 1-14.

Brander J. A. and Krugman P. R. (1983) "A 'Reciprocal Dumping' Model of International Trade", *Journal of International Economics*, 15, 313-321.

Brander J. A. and Spencer B. J. (1981) "Tariffs and the Extraction of Foreign Monopoly Rents under Potential Entry", *Canadian Journal of Economics*, 14, 371-389.

Brander J. A. and Spencer B. J. (1983) "International R&D Rivalry and Industrial Strategy", *Review of Economic Studies*, 50, 707-722.

Brander J. A. and Spencer B. J. (1984) "Tariff Protection and Imperfect Competition", in H. Kierzkowski (ed.), *Monopolistic Competition and International Trade*, Oxford University Press.

Brander J. A. and Spencer B. J. (1985) "Export Subsidies and

International Market Share Rivalry", *Journal of International Economics*, 18, 83-100.

Capozza D. and Van Order R. (1978) "A Generalized Model of Spatial Competition", *American Economic Review*, 68, 896-909.

Capozza D. and Van Order R. (1980) "Unique Equilibria, Pure Profits, and Efficiency in Location Models", *American Economic Review*, 70, 1046-1053.

Caves R. E. (1981) "Intra-Industry Trade and Market Structure in the Industrial Countries", *Oxford Economic Papers*, 33, 203-223.

Caves R., *et al.* (1991) *Technical Inefficiency in Manufacturing Industry*, Yale University Press.

Chamberlin E. (1933) *The Theory of Monopolistic Competition*, Harvard University Press, Cambridge.

Coates E. H. (1927) "The Incidence of Income Tax", Appendix XI to the *Report of the Committee on National Debt and Taxation*, HMSO.

Cox D. and Harris R. (1985) "Trade Liberalization and Industrial Organization: Some Estimates for Canada", *Journal of Political Economy*, 93, 115-145.

Cremer H. and Thisse J. -F. (1991) "Location Models of Horizontal Differentiation: A Special Case of Vertical Differentiation Models", *Journal of Industrial Economics*, 49, 383-390.

de Melo J. and Urata S. (1986) "The Influence of Increased Foreign Competition on Industrial Concentration and Profitability", *International Journal of Industrial Organization*, 4, 287-304.

de Meza D. (1979) "Commercial Policy towards Multinational Monopolies- Reservations on Katrak", *Oxford Economic Papers*, 31, 334-337.

Demsetz H. (1973) "Industry Structure, Market Rivalry, and Public Policy", *Journal of Law and Economics*, **16**, 1-9.

Deneckere R. and Rothschild M. (1992) "Monopolistic Competition and Preference Diversity", *Review of Economic Studies*, **59**, 361-373.

de Palma A., Ginsburgh V., Papageorgiou Y. and Thisse J. -F, (1985) "The Principle of Minimum Differentiation Holds under Sufficient Heterogeneity", *Econometrica*, **53**, 767-781.

De Rosa L. A. and Goldstein M. (1981) "Import Discipline in the U.S. Manufacturing Sector", *International Monetary Fund Staff Papers*, 600-634.

Dierker E. (1991) "Competition for Customers", in W. A. Barnett, B. Cornet, C. D'Aspremont, J. J. Gabszewicz and A. Mas-Colell (eds.) *Equilibrium Theory and Applications*, Cambridge University Press.

Dixit A. K. (1984) "International Trade Policy for Oligopolistic Industries", *Economic Journal*, supplement 1-16.

Dixit A. and Grossman G. (1986) "Targeted Export Promotion with Several Oligopolistic Industries", *Journal of International Economics*, **21**, 233-250.

Dixit A. K. and Kyle A. S. (1985) "The Use of Protection or Subsidies for Entry Promotion and Deterrence", *American Economic Review*, **75**, 139-152.

Dixit A. K. and Norman V. (1980) *The Theory of International Trade*, Cambridge University Press, Cambridge.

Dixit A. and Stiglitz J. E. (1977) "Monopolistic Competition and Optimum Product Diversity", *American Economic Review*, **67**, 297-308.

Dixit A. and Stiglitz J. E. (1979) "Monopolistic Competition and Optimum Product Diversity: Reply", *American Economic Review*, 69, 961-963.

Dollar D. D. (1986) "Technological Innovation, Capital Mobility, and the Product Cycle in North-South Trade", *American Economic Review*, 76, 177-190.

Dollar D. D. and Wolff E. N. (1993) *Competitiveness, Convergence, and International Specialization*, The MIT Press.

Dollar D. D., Wolff E. N. and Baumol W. J. (1988) "The Factor-Price Equalization Model and Industry Labor Productivity: An Empirical Test across Countries", in R. Feenstra (ed.) *Empirical Methods for International Trade*, The MIT Press.

Domowitz I., Hubbard R. G. and Petersen B .C. (1988) "Market Structure and Cyclical Fluctuations in U.S. Manufacturing, *The Review of Economics and Statistics*, 70, 1, 55-66.

Dosi G. (1988) "Sources, Procedures and Microeconomic Effects of Innovation", *Journal of Economic Literature*, 26, 1120-1171.

Dosi G., Freeman C., Nelson R., Silverberg G. and Soete L. (1988) *Technical Change and Economic Theory*, Pinter Publishers.

Dosi G., Pavitt K. and Soete L. (1990) *The Economics of Technical Change and International Trade*, Harvester Wheatsheaf.

Eaton B. C. and Lipsey R. G. (1977) "The Introduction of Space into the Neo-classical Model of Value Theory", in M. J. Artis and A. R. Nobay (eds.), *Studies in Modern Economic Analysis*, Basil Blackwell.

Eaton B. C. and Lipsey R. G. (1978) "Freedom of Entry and the Existence of Pure Profits", *Economic Journal*, 88, 455-469.

Eaton B. C. and Wooders M. H. (1985) "Sophisticated Entry in a Model of Spatial Competition", *Rand Journal of Economics*, 16, 282-297.

Eaton J. and Grossman G. M. (1986) "Optimal Trade and Industry Policy under Oligopoly", *Quarterly Journal of Economics*, 2, 383-406.

EldorR. and Levin D. (1990) "Trade Liberalization and Domestic Monopoly: A Welfare Analysis," *International Economic Review*, 31, 773-782.

Encaoua D. and Jacquemin A. P. (1980) "Degree of Monopoly, Indices of Concentration, and Theory of Entry", *International Economic Review*, 21, 87-105.

Ethier W. (1979) "Internationally Decreasing Costs and World Trade", *Journal of International Economics*, 9, 1-24.

Ethier W. (1982a) "Decreasing Costs in International Trade and Frank Graham's Argument for Protection", *Econometrica* 50, 1243-1268.

Ethier W. (1982b) "National and International Returns to Scale in the Modern Theory of International Trade", *American Economic Review*, 72, 389-405.

Falvey R. E. (1981) "Commercial Policy and Intra-Industry Trade", *Journal of International Economics*, 11, 495-511.

Falvey R. E. (1994) "The Theory of International Trade", in D. Greenaway and L. A. Winters (eds.) *Surveys in International Trade*, Blackwell.

Feenstra R. (1990) "Trade and Uneven Growth", *National Bureau of Economic Research*, Working Paper No. 3276.

Feenstra R. and Judd K. (1982) "Tariffs, Technology Transfer, and Welfare", *Journal of Political Economy*, 90, 1142-1165.

Findlay R. and Kierzkowski H. (1983) "International Trade and Human

Capital: A Simple General Equilibrium Model", *Journal of Political Economy*, **91**, 957-978.

Finger J. M. (1975) "Trade Overlap and Intra-Industry Trade", *Economic Inquiry*, **XIII**, 4, 581-589.

Fishelson, G. and Hillman A. L. (1979) "Domestic Monopoly and Redundant Tariff Protection", *Journal of International Economics*, 9, 47-55.

Flam H. and Helpman E. (1987) "Vertical Product Differentiation and North-South Trade", *American Economic Review*, **77**, 810-822.

Flam H. and Helpman E. (1987) "Industrial Policy under Monopolistic Competition", *Journal of International Economics*, **22**, 79-102.

Frankel H. (1943) "Industrialization of Agricultural Countries and the Possibilities of a New International Division of Labour", *Economic Journal*, **53**, 188-201.

Fung K. C. (1992) "Economic Integration as Competitive Discipline", *International Economic Review*, **33**, 837-847.

Gasiorek M., Smith A. and Venables A. (1991) "Completing the Internal Market in the EC: Factor Demands and Comparative Advantage", in Winters L. A. and Venables A., (eds.) *European Integration: Trade and Industry*, Cambridge University Press.

Gee J. M. A. (1990) *The Theory of the Spatial Firm and Industry: An Marshallian Approach*, Harvester Wheatsheaf, Hemel Hempstead.

Graham F. (1923) "Some Aspects of Protection Further Considered", *Quarterly Journal of Economics*, **37**, 199-227.

Green A., Harris C. and Mayes D. G. (1991) "The Estimation of Technical Inefficiency in Manufacturing Industry", *Applied Economics*, **23**, 1637-1647.

Greenaway D. and Milner C. R. (1989) "The Growth and Significance of Intra-Industry Trade", in J. Black and A. MacBean (eds.) *Causes of Changes in the Structure of International Trade, 1960-85*, Macmillan.

Greenhut M. L., Norman G. and Hung C. -S. (1987) *The Economics of Imperfect Competition: A Spatial Approach*, Cambridge University Press.

Grinols E. L. (1993) "Increasing Returns and the Shift from Customs Union to Common Market", *Regional Science and Urban Economics*, 23, 315-335.

Gros D. (1987) "Protectionism in a Framework with Intra-Industry Trade", *International Monetary Fund Staff Papers*, 34, 86-114.

Grossman G. M. (1986) "Strategic Export Promotion: A Critique", in Paul R. Krugman, (ed.), *Strategic Trade Policy and the New International Economics*, The MIT Press.

Grossman G. M. and Helpman E. (1989) "Product Development and International Trade", *Journal of Political Economy*, XCVII, 1261-83.

Grossman G. and Helpman E. (1990a) "Trade Innovation, and Growth", *American Economic Review, Papers and Proceedings*, 80, 2, 86-91.

Grossman G. M. and Helpman E. (1990b) "Comparative Advantage and Long Run Growth", *American Economic Review*, 80, 796-815.

Grossman G. M. and Helpman E. (1991a) "Quality Ladders and the Theory of Growth", *Review of Economic Studies*, 58, 43-61.

Grossman G. M. and Helpman E. (1991b) "Quality Ladders and Product Cycle", *Quarterly Journal of Economics*, 106, 557-586.

Grossman G. M. and Helpman E. (1991c) "Trade, Knowledge Spillovers, and Growth", *European Economic Review*, 35, 517-526.

Grossman G. M. and Helpman E. (1991d) *Innovation and Growth in the Global Economy*, The MIT Press.

Grubel H. G. (1967) "Intra-Industry Specialization and the Pattern of Trade", *Canadian Journal of Economics*, 33, 374-388.

Grubel H. G. and Lloyd P. J. (1975) *Intra-Industry Trade: The Theory and Measurement of International Trade in Differentiated Products*, Wiley.

Haberler G. (1936) *The Theory of International Trade With its Applications to Commercial Policy*, William Hodges.

Hanoch G. (1975) "The Elasticity of Scale and the Shape of Average Costs", *American Economic Review*, 65, 492-497.

Hart O. D. (1985a) "Monopolistic Competition in the Spirit of Chamberlin: A General Model", *Review of Economic Studies*, L11, 529-546.

Hart O. D. (1985b) "Monopolistic Competition in the Spirit of Chamberlin: Special Results", *Economic Journal*, 95, 889-908.

Hart P. E. and Shipman A. (1992) "The Variation of Productivity within British and German Industries", *The Journal of Industrial Economics*, XL, 417-425.

Havrylyshyn O. and Civan E. (1983) "Intra-Industry Trade and the Stage of Development: A Regression Analysis of Industrial and Developing Countries", in P.K.M. Tharakan (ed.) *Intra-Industry Trade: Empirical and Methodological Aspects*, North-Holland.

Helpman E. (1981) "International Trade in the Presence of Product Differentiation, Economies of Scale, and Monopolistic Competition: A Chamberlinian-Heckscher-Ohlin Approach", *Journal* *of International Economics*, 11, 305-340.

Helpman E. (1984a) "A Simple Theory of Trade with Multinational Corporations", *Journal of Political Economy*, 92, 451-472.

Helpman E. (1984b) "Increasing Returns, Imperfect Markets, and Trade Theory", in R. W. Jones and Kenen P. B. (eds.) *Handbook of International Economics*, vol I, North-Holland.

Helpman E. (1990) *Monopolistic Competition in Trade Theory*, Special Papers in International Economics No. 16, Princeton, N.J., Princeton University, International Finance Section, June.

Helpman E. and Krugman P. R. (1985) *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy*, The MIT Press, Cambridge.

Helpman E. and Razin A. (1984) "Increasing Returns, Monopolistic Competition, and Factor Movements: A Welfare Analysis", in H. Kierzkowski (ed.), *Monopolistic Competition and International Trade*, Oxford University Press.

Herberg H. and Kemp M. C. (1969) "Some Implications of Variable Returns to Scale", *Canadian Journal of Economics*, 11, 403-415.

Hesse H. (1974) "Hypotheses for the Explanation of Trade between Industrial Countries, 1953-1970", in H. Giersch (ed.) *The International Division of Labour: Problems and Perspectives*, Tubingen.

Hirschman A. O. (1945) *National Power and the Structure of Foreign Trade*, University of California Press.

Hopenhayn H. A. (1992) "Entry, Exit, and Firm Dynamics in Long Run Equilibrium", *Econometrica*, 60, 1127-1150.

Horn H., Lang H. and Lundgren S. (1995) "Managerial Effort

Incentives, X-inefficiency and International Trade", *European Economic Review*, **39**, 117-138.

Horstmann I. and Markusen J. R. (1986) "Up the Average Cost Curve: Inefficient Entry and the New Protectionism", *Journal of International Economics*, (May) **20**, 225-248.

Hotelling H. (1929) "Stability in Competition", *Economic Journal*, **39**, 41-57.

Ishikawa J. (1992) "Trade Patterns and Gains from Trade with an Intermediate Good Produced under Increasing Returns to Scale", *Journal of International Economics*, **32**, 57-81.

Jacquemin A. (1982) "Imperfect Market Structure and International Trade - Some Recent Research", *Kiklos*, **35**, 75-93.

Jacquemin A. (1987) *The New Industrial Organization: Market Forces and Strategic Behavior*, Clarendon Press.

Jones R. W. (1968) "Variable Returns to Scale in General Equilibrium Theory, *International Economic Review*, **9**, 261-272.

Jones R. W. (1987) "Trade, Taxes and Subsidies with Imperfect Competition", *Economic Letters*, **23**, 375-379.

Jones R. W. and Kenen P. B. (1984) *Handbook of International Economics*, Amsterdam: North-Holland, Vol. 1.

Jones R. W. and Neary J. P. (1984) "The Positive Theory of International Trade", in R. W. Jones and P. B. Kenen (eds), *Handbook of International Economics*, Amsterdam: North-Holland, 1.

Jones R. W. and Takemori S. (1989) "Foreign Monopoly and Optimal Tariffs for the Small Open Economy", *European Economic Review*, 33, 1691-1707.

Kaldor N. (1935) "Market Imperfection and Excess Capacity", *Economica*, 2, 35-50.

Katrak, H. (1977) "Multinational Monopolies and Commercial Policy", *Oxford Economic Papers*, 29, 283-291.

Krishna K. (1989) "Trade Restrictions as Facilitating Practices", *Journal of International Economics*, 26, 251-270.

Krugman P. R. (1979a) "Increasing Returns, Monopolistic Competition, and International Trade", *Journal of International Economics*, 9, 469-479.

Krugman (1979b) "A Model of Innovation, Technology Transfer, and the World Distribution of Income", *Journal of Political Economy*, **87**, 253-266.

Krugman P. R. (1980) "Scale Economies, Product Differentiation, and the Pattern of Trade", *American Economic Review*, **70**, 950-959.

Krugman P. R. (1981) "Intra-Industry Specialization and the Gains from Trade", *Journal of Political Economy*, **89**, 959-973.

Krugman P. (1982) "Trade in Differentiated Products and the Political Economy of Trade Liberalization", in J. N. Bhagwati, *Import Competition and Response*, The University of Chicago Press.

Krugman P. R. (1984) "Import Protection as Export Promotion: International Competition in the Presence of Oligopolies and Economies of Scale", in H. Kierzkowski (ed.), *Monopolistic Competition and International Trade*, Oxford University Press.

Krugman P. R. (1990) *Rethinking International Trade*, The MIT Press.

Krugman P. R. (1991a) *Geography and Trade*, The MIT Press.

Krugman P. R. (1991b) "Increasing Returns and Economic Geography", *Journal of Political Economy*, **XCIX**, 483-499.

Krugman P. R. (1995) "Growing World Trade: Causes and Consequences", *Brooking Papers on Economic Activity*.

Krugman P. and Venables A. (1990) "Integration and the Competitiveness of Peripheral Industry". In B. Christopher and J. B. de Macedo, (eds.), *Unity with Diversity in the European Community*, Cambridge University Press.

Krugman P. and Venables A. (1995) "Globalization and the Inequality of Nations", paper presented at the conference *"Recent Developments in International Economics"*, Aix en Provence 14-16 June 1995.

Lancaster, K. J. (1966) "A New Approach to Consumer Theory", *Journal of Political Economy*, **74**, 132-157.

Lancaster, K. J. (1971) *Consumer Demand: A New Approach*, Columbia University Press.

Lancaster, K. J. (1979) *Variety, Equity and Efficiency*, Columbia University Press, New York.

Lancaster, K. J. (1980) "Intra-Industry Trade Under Perfect Monopolistic Competition", *Journal of International Economics*, **10**, 151-175.

Lancaster, K. J. (1984) "Protection and Product Differentiation", in H. Kierzkowski (ed.), *Monopolistic Competition and International Trade*, Oxford University Press, Oxford.

Lancaster K. (1991a) *"Modern Consumer Theory"*, Edward Elgar.

Lancaster K. (1991b) "The `Product Variety´ Case for Protection", *Journal of International Economics*, **31**, 1-26.

Lawrence C. and Spiller P. T. (1983) "Product Diversity, Economies of Scale and International Trade", *Quarterly Journal of Economics*,

XCVII, 63-83.

Lederer P. J. and Hurter A. P. (1986) "Competition of Firms: Discriminatory Pricing and Location", *Econometrica*, 54, 623-640.

Lerner A. P. (1932) "The Diagrammatic Representation of Cost Conditions in International Trade", *Economica*, 34, 346-356.

Levinsohn J. (1993) "Testing the Imports-As-Market-Discipline Hypothesis", *Journal of International Economics*, 35, 1-22.

Lippman S. A., McCardle K. F. and Rumelt R. P. (1991) "Heterogeneity Under Competition", *Economic Inquiry*, **XXIX**, 774-782.

Lippman S. A. and Rumelt R. P. (1982) "Uncertain Imitability: An Analysis of Interfirm Differences in Efficiencies Under Competition", *Bell Journal of Economics*, 13, 418-438.

Lipsey, R. E. (1976) "Review of Grubel, H. G. and Lloyd, P. J. 'Intra-Industry Trade (1975)'", *Journal of International Economics*, 6, 312-314.

Loertscher R. and Wolter F. (1980) "Determinants of Intra-Industry Trade: Among Countries and Across Industries", *Weltwirtschaftliches Archiv*, 116, 281-293.

Lovasy, G. (1941) "International Trade Under Imperfect Competition", *Quarterly Journal of Economics*, **LV**, 567-583.

MacDonald J. M. (1994) "Does Import Competition Force Efficient Production?", *The Review of Economics and Statistics*, 721-727.

MacLeod W. B., Norman G. and Thisse J. -F. (1988) "Price Discrimination and Equilibrium in Monopolistic Competition", *International Journal of Industrial Organization*, 6, 429-446.

Manski C. F. and McFadden D. (eds.) (1981) *Structural Analysis of Discrete Data with Econometric Applications*, The MIT Press.

Markusen J. R. (1981) "Trade and the Gains from Trade with Imperfect Competition", *Journal of International Economics*, **11**, 531-551.

Markusen J. R. (1986) "Explaining the Volume of Trade: An Eclectic Approach", *American Economic Review*, **76**, 1002-1011.

Markusen J. R. (1989) "Trade in Producer Services and in Other Specialized Intermediate Inputs", *American Economic Review*, 79, 85-95.

Markusen J. R. and Melvin J. R. (1981) "Trade, Factor Prices, and Gains from Trade with Increasing Returns to Scale", *Canadian Journal of Economics*, **XIV**, 450-469.

Markusen J. R. and J. R. Melvin (1984) "The Gains-from Trade Theorem with Increasing Returns to Scale", in H. Kierzkowski (ed.), *Monopolistic Competition and International Trade*, Oxford University Press.

Markusen J. R. and Venables A. J. (1988) "Trade Policy with Increasing Returns and Imperfect Competition: Contradictory Results from Competing Assumptions", *Journal of International Economics*, **24**, 299-316.

Marshall A. (1879) "The Pure Theory of Foreign Trade", reprinted by the London School of Economics, 1930.

Matthews R. C. O. (1949) "Reciprocal Demand and Increasing Returns", *Review of Economic Studies*, **37**, 149-158.

Mayer W. (1974) "Variable Returns to Scale in Equilibrium Theory: A Comment", *International Economic Review*, **15**, 225-235.

Melvin J. (1969) "Increasing Returns to Scale as a Determinant of Trade", *Canadian Journal of Economics*, **2**, 3, 389-402.

Melvin J. R. (1969) "Intermediate Goods, the Production Possibility

Curve, and Gains from Trade", *Quarterly Journal of Economics*, **83**, 141-151.

Melvin J. R. and Warne R. D. (1973) "Monopoly and the Theory of International Trade", *Journal of International Economics*, **3**, 117-134.

Montagna C. (1995) "Monopolistic Competition with Firm-Specific Costs", *Oxford Economic Papers*, **47**, 318-328.

Montagna C. (1995) "Monopolistic Competition, Firm-Specific Costs and Employment", forthcoming, *Dundee Discussion Papers*.

Neary J. P. (1994) "Cost Asymmetries in International Subsidy Games: Should Governments Help Winners or Losers?", *Journal of International Economics*, **37**, 197-218.

Nelson R. R. and Winter S. (1982) *An Evolutionary Theory of Economic Change*, Belknap Press.

Neven D. (1986) "On Hotelling's Competition with Non-uniform Customer Distributions", *Economic Letters*, **21**, 121-126.

Neven D. (1987) "Endogenous Sequential Entry in a Spatial Model", *International Journal of Industrial Organization*, 5, 419-434.

Norman V. (1989) "EFTA and the Internal European Market", *Economy Policy*, October 9, 423-65.

Norman V. (1991) "1992 and EFTA", in Winters L. A. and Venables A., (eds.) *European Integration: Trade and Industry*. Cambridge University Press.

Novshek W. (1980) "Equilibrium in Simple Spatial (or Differentiated Product) Models", *Journal of Economic Theory*, **22**, 313-326.

Ohlin B. (1933) *Interregional and International Trade*, Harvard University Press.

Pagoulatos E. and Sorensen R. (1975) "Two-Way International Trade: An Econometric Analysis", *Weltwirtschaftliches Archiv*, **111**, 454-465.

Panagariya A. (1980) "Variable Returns to Scale in General Equilibrium Theory Once Again", *Journal of International Economics*, **10**, 499-526.

Panagariya A. (1981) "Variable Returns to Scale and Patterns of Specialization", *American Economic Review*, **71**, 221-230.

Pascoa M. R. (1993) "Noncooperative Equilibrium and Chamberlinian Monopolistic Competition", *Journal of Economic Theory*, **60**, 335-353.

Perloff, J. M. and Salop S. C. (1985) "Equilibrium with Product Differentiation", *Review of Economic Studies*, **52**, 107-120.

Pettengill J. S. (1979) "Monopolistic Competition and Optimum Product Diversity: Comment", *American Economic Review*, **69**, 957-960.

Pomfret R. (1992) "International Trade Policy with Imperfect Competition", *Special Papers in International Economics*, International Finance Section, Princeton.

Porter M. (1990) "The Competitive Advantage of Nations", Macmillan.

Rayment P. B. W. (1976) "The Homogeneity of Manufacturing Industries with Respect to Factor Intensity: the Case of the UK", *Oxford Bulletin of Economics and Statistics*, **38**, 203-209.

Rayment P. B. W. (1983) "Intra-'Industry' Specialization and the Foreign Trade of Industrial Countries" in S. F. Frowen (ed.) *Controlling Industrial Economics: Essays in Honour of C.T. Saunders*, Macmillan.

Rivera-Batiz L. A. and Romer P. M. (1991a) "Economic Integration and

Endogenous Growth", *Quarterly Journal of Economics*, 106, 532-556.

Rivera-Batiz L. A. and Romer P. M. (1991b) "International Trade with Endogenous Technological Change", *European Economic Review*, 35.

Rivera-Batiz L. A. and Xie D. (1992) "GATT, Trade and Growth", *American Economic Review*, 82, 422-427.

Rivera-Batiz L. A. and Xie D. (1993) "Integration among Unequals", *Regional Science and Urban Economics*, 23, 337-354.

Robinson J. (1933) *The Economics of Imperfect Competition*, MacMillan.

Robinson J. (1973) "The Need for a Reconsideration of the Theory of International Trade", in M. B. Connolly and A. K. Swoboda (eds.), *International Trade and Money*, George Allen and Unwin.

Romer P. M. (1990) "Endogenous Technological Change", *Journal of Political Economy*, XCVIII, S71-S102.

Rosenberg N. (1982) *Inside the Black Box*, Cambridge University Press.

Salop S. C. (1979) "Monopolistic Competition with Outside Goods", *Bell Journal of Economics*, 10, 141-156.

Sattinger M. (1984) "Value of an Additional Firm in Monopolistic Competition", *Review of Economic Studies*, 51, 321-332.

Schmalensee R. (1982) "The New Industrial Organization and the Economic Analysis of Modern Markets", in W. Hildebrand (ed.) *Advances in Economic Theory*, Cambridge University Press.

Schmalensee R. (1989) "Inter-Industry Differences of Structure and Performance", in R. Schmalensee and R. Willig (eds), *Handbook of Industrial Organization*, North-Holland, Amsterdam.

Schott J. (1988) *United States-Canada Free Trade: An Evaluation of the Agreement*, Institute for International Economics, Washington.

Sleuwaegen L. and Yamawaki H. (1988) "The Formation of the European Common Market and Changes in Market Structure and Performance", *European Economic Review*, 32, 1451-1475.

Smith A. (1989) "The Market for Cars in the Enlarged European Community", Discussion Paper No. 360, Centre for Economic Policy Research, London.

Smith A. (1994) "Imperfect Competition and International Trade", in D. Greenaway and L. A. Winters (eds.) *Surveys in International Trade*, Blackwell.

Smith A. and Venables A. J. (1988) "Completing the Internal Market in the European Community: Some Industry Simulations", *European Economic Review*, 32, 1501-1525.

Soete L. (1990) "Technical Change Theory and International Trade Competition", in J. de la Mothe and L. M. Ducharme (eds.) *Science, Technology, and Free Trade*, Pinter Publishers.

Spence M. (1976) "Product Selection, Fixed Costs, and Monopolistic Competition" *Review of Economic Studies*, 43, 217-235.

Startz R. (1989) "Monopolistic Competition As a Foundation for Keynesian Macroeconomic Models", *Quarterly Journal of Economics*, 104, 737-752.

Stigler G. J. (1949) "Monopolistic Competition in Retrospect" in *Five Lectures on Economic Problems*, London School of Economics, London.

Sutton J. (1992) *Sunk Costs and Market Structure*, The MIT Press.

Svedberg P. (1979) "Optimal Tariff Policy on Imports from Multinationals", *Economic Record*, 55, 64-67.

Swann P. (1993) "Identifying Asymmetric Competitor Networks from Characteristics Data: Application to the Spreadsheet Software Market", *Economic Journal*, **103**, 468-473.

Taussing F. W. (1919) "Price Fixing as seen by a Price-Fixer", *Quarterly Journal of Economics,* **33**, 205-241.

Toh K, (1982) "A Cross-Section Analysis of Intra-Industry Trade in US Manufacturing Industries", *Weltwirtschaftliches Archiv*, **118**, 281-300.

Venables A. J. (1985) "Trade and Trade Policy with Imperfect Competition: The Case of Identical Products and Free Entry", *Journal of International Economics*, **19**, 1-19.

Venables A. J. (1987) "Trade and Trade Policy with Differentiated Products", *Economic Journal*, **97**, 700-717.

Venables A. J. (1990) "The Economic Integration of Oligopolistic Markets", *European Economic Review*, **34**, 753-773.

Venables A. J. (1994) "Integration and the Export Behaviour of Firms: Trade Costs, Trade Volumes and Welfare", *Weltwirtschaftliches Archiv*, 118-132.

Verdoorn P. J. (1960) "The Intra-block Trade of Benelux", in E. A. G. Robinson (ed.) *Economic Consequences of the Size of Nations*, Macmillan.

Viner, J. (1937) *Studies in the Theory of International Trade*, Harper & Brothers.

von Ungern-Sternberg T. (1991) "Monopolistic Competition on the Pyramid", *The Journal of Industrial Economics,* **XXXIX**, 355-368.

Waterson, M. (1990) "Product Differentiation and Profitability: An Asymmetric Model", *The Journal of Industrial Economics*, **XXXVIII**, 113-130.

Wathieu L. (1993) "Productivity Gaps and Labour Underemployment", *Economics Letters*, **41**, 35-39.

Weitzman M. L. (1985) "The Simple Macroeconomics of Profit Sharing", *American Economic Review*, **75**, 937-953.

Wonnacott P. (1987) *The United States and Canada: The Quest for Free Trade*, Institute for International Economics, Washington.

Wright D. J. (1993) "International Technology Transfer with an Information Asymmetry and Endogenous Research and Development", *Journal of International Economics*, **35**, 47-67.

Yano M. (1989) "Voluntary Restraints and Expectations: An Analysis of Export Quotas in Oligopolistic Markets", *International Economic Review*, **30**, 707-723.

Young A. (1991) "Learning by Doing and the Dynamic Effects of International Trade", *Quarterly Journal of Economics*, CVI, 369-405.